November 23, 1922

Engineering News-Record

Devoted to Civil Engineering and Contracting
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Building a Concrete Arch Bridge Around an Old Steel Bridge

Old Masonry Piers Supporting Trusses Changed Into Arch Piers and New Arch Piers Placed at Half-Way Points. Steel Bridge Used for Construction Platform

The Reaction Against Highway Expenditures

An Examination of the Causes Underlying the Evident Reluctance on the Part of the Public To Authorize Greater Highway Expenditures—What Must Be Done To Promote Roads

Logging Railway Practice

How They Build and Maintain the Railways Which Bring out the Lumber from the Great Northwestern Forests

From Job and Office:

A Dozen Short Articles Each Showing How the Engineer and the Contractor Met and Solved a Difficult Problem

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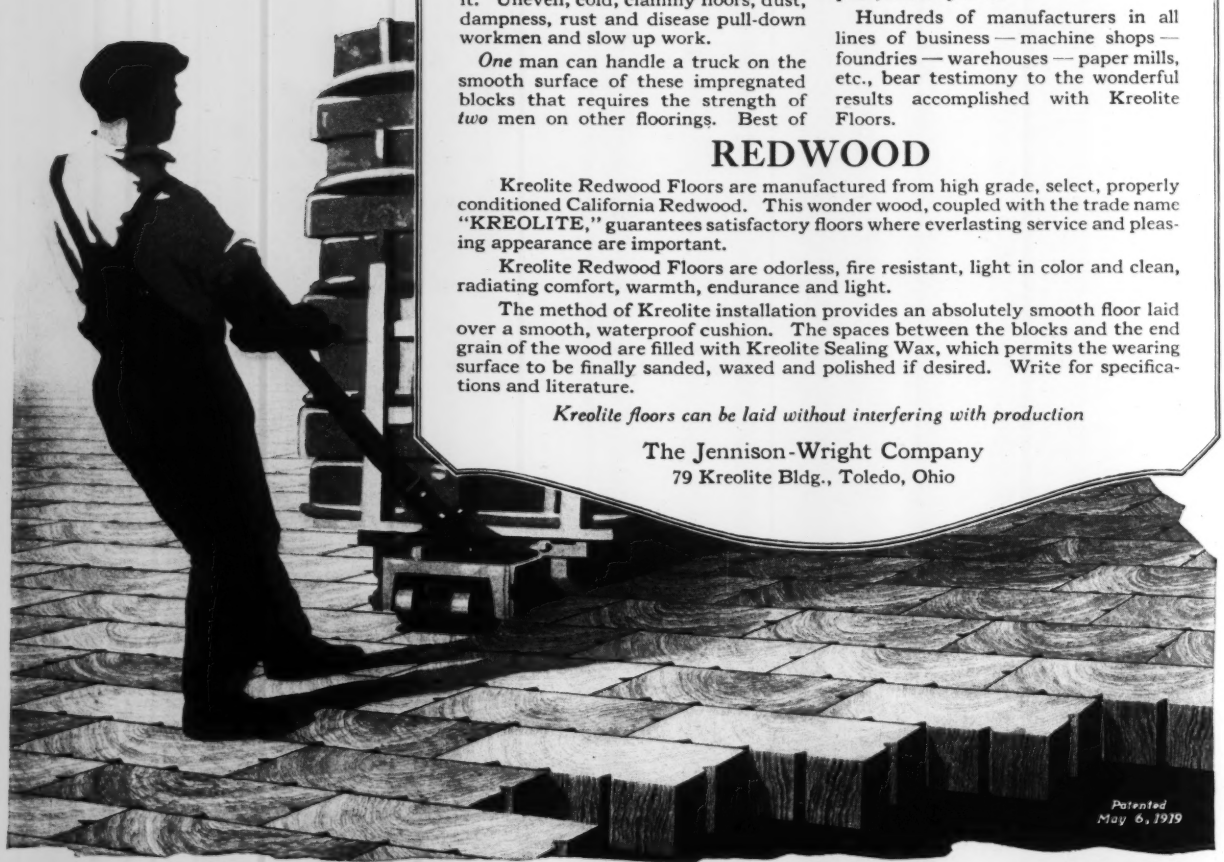

WOOD BLOCK FLOORS

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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Fighting Anti-Highway Feeling

RECKLESS advocacy of road building of the type made notorious some years ago in the "good roads" propaganda is ill-advised and *Engineering News-Record* would never be a party to it. The systematic and scientific construction of a road system throughout the country is, on the other hand, held to be a necessary step forward in the development of transportation and an essential element in economic progress. For that reason any tendency which promises either to restrict the national building of roads or to return to piecemeal construction by local agencies is dangerous and should be first recognized and then opposed. This is the reason for the editorial review on another page outlining the current reaction against highway expenditure. It is important that those responsible for our road building programs should understand the situation and on the basis of such understanding set out to remedy it.

Clearing the Streets

WHILE we have been putting passenger travel in large cities underground and overhead so far as possible, we have kept freight traffic on the surface, and now find it constituting a fair half of the alarming congestion which is the biggest problem of city engineers and planners today. Chicago alone has an underground freight transportation system, a development unique in its history and construction as well as its general type. To judge from an account of its working, as given on p. 877 of this issue, the freight tunnels are by no means fully utilized; yet even so the system has done a great deal toward limiting the congestion in the narrow streets of the Loop district to a passable degree. New York or Philadelphia suffer more from traffic congestion than Chicago in spite of the fact that they have less intense crowding of business and relatively more ample street facilities. If the freight tunnel system is to be credited for this result in part, its possible application elsewhere than in Chicago invites thought. City traffic congestion cannot long continue to grow at its present rate without radical relief.

Research in Practice

AS WE build we learn. Tests of structural elements are now being carried out to guide in the detail designing of the Philadelphia-Camden bridge, and as in every such case the tests will yield fully as much information for other work as for this one enterprise. In each large and bold piece of construction there are new problems, for progressive engineering work is never far from the frontier of the sciences and arts on which it depends. Research to solve these problems is an excellent investment, since it helps to make the construction efficient and dependable. In the past such research based on the immediate requirements of practice has brought forth some of the most important contributions to engineering progress. Future progress will be firmly assured if we continue to make each problem of construction the occasion for further study and test. Enterprises of unusual magnitude present the most obvious opportunities, but the problems arising in ordinary work, though they may be smaller, are not less worthy of an attempt to find their solution. It is not customary to include a research item in the estimates or appropriations for the engineering cost of a piece of work, but ultimately, we may hope, such an item will have an acknowledged place; the expenditure will never fail to pay a profit.

Occasional Use

SHIPS drawing more than 35 ft. and in lengths approaching 1,000 ft. will pay only on the comparatively short ocean run between New York and Europe but because the special demand on that route warrants such abnormal vessels they continue to be built and, what is more, they influence the design of ports and port facilities everywhere. The locks at Panama, for instance, are 1,000 ft. long, not for the traffic they pass but because room must be provided for any ship afloat. Dry docks, too, rarely see a ship over 600 ft. long but because there must be places where "Leviathan," "Aquitania" and their like can be docked, we see "1,000-ft. drydocks" spotted around the world, in Liverpool, in Boston, in San Francisco, at Panama, and in the St. Lawrence at Quebec. Once in a great while do they justify their great size. Just now, for instance the 1,140-ft. dock at Boston, built by Massachusetts and sold to the federal government, is occupied by the British "Majestic," largest ship in the world. The Boston dry dock is several years old but this is the first time anywhere near her total capacity has been required. It might be interesting to figure out how much more it costs to provide for this very occasional use.

The Roadbuilding Season

HOW long is the roadbuilding season? Obviously it is not as long in Dakota as it is in Arizona and it is longer for gravel surfacing than it is for concrete paving, yet most textbooks and many engineers speak of it as some definite period. All computations in the old textbooks on macadam road construction are based on a 200-day working season. This figure has in some way been carried on into modern paved road practice and has led to common error in reckoning progress in road construction programs. It is interesting, therefore, to observe the statistics recently collected by the Bureau of Public Roads of the periods considered practicable for road construction in the different states. Allowing for Sundays only, there are 313 working days in the year and three states only report that grading is possible on 300 days. Florida, Louisiana and Texas report 265-, 260- and 275-day working seasons. In the North there are Maine with 110 working days, Wisconsin with 153 and Oregon with 100. In 14 states grad-

ing is considered to be impracticable after Nov. 1. Gravel surfacing, it is stated by ten states, can be placed during a season exceeding 200 days, but most states set the period as between 120 and 200 days. In 26 states concrete pavement can be laid on from 100 to 150 days and in 16 states on from 150 to 200 days. In 28 states all construction has generally ceased by Nov. 1. These figures, it should be remembered, register prevailing practice. They should be supplemented by others showing the possible extension of the roadbuilding season for the several types of roads in the different temperature zones. With a roadbuilding season so brief, perhaps half the working days of the year as the statistics indicate, the problem before highway engineers is to determine means for extending road work over a longer period of the year.

Public Works and Competition

IT IS commonly believed that public improvements are constructed in response to public needs, and that the demand resulting from such needs is the impelling force that causes the improvements to be built. This belief is no doubt true in a broad sense, although, as everyone knows, public demand is often quite inarticulate. But other influences are sometimes the immediate motives for public works construction, by arousing if not creating the demand. A case in point is found in the Hudson River bridge situation. The 150-mile length of river from Albany to its mouth has always been without a highway bridge, and traffic has contented itself with slow, awkward ferry service. Even a city as large as Poughkeepsie never seemed to feel the need for better means of crossing; at any rate no loud demand for a bridge came from that city. Some months ago, however, a group of enterprising engineers conceived that a bridge could be built to advantage at Anthony's Nose, which is some distance below Poughkeepsie, and proceeded to form a company and obtain a charter for its construction. This project apparently revealed to Poughkeepsie its own need for a bridge, for at once active agitation began, first to block the Anthony's Nose charter and, when this move failed, to develop an independent bridge project. In consequence careful engineering studies were entered upon, and if the men back of the proposal retain their faith it is reasonably certain that the bridge will come into existence. There can be no doubt that the traffic demands and warrants its construction, but the traffic demand in itself would have remained silent for years. If the bridge is built it will be due to the spur of competition. Thus it appears that our old friend of the economics primers has an important meaning even for the engineer, and should be worth cultivating.

Economics of Logging Railways

THE economic aspect of railway projects assumes special and very practical importance when such peculiar conditions as the following must be taken into consideration: (1) A definite and predetermined total amount of traffic, which will be handled in a period of years, after which the railway will have only a salvage value; (2) paying traffic all in one direction and decreasing gradually from the outer portions of the line; (3) possible suspension of traffic during two or three winter months. But these are actual governing conditions in logging railway practice, as explained in an article on another page. It will be evident that the engineer who has to provide a railway for the removal of timber from a certain forested area or property in mountainous country has very special problems to consider in the economics of location, construction and operation. With the economic aspect of such large importance, it is evident also that work of this kind cannot be entrusted simply to a construction foreman. There is a somewhat general opinion that logging railway work is of a crude and pick-and-shovel quality, involving little or no engineering skill. But from the article noted above it will be seen that most careful consideration is required to produce a line that will provide economically for adequate facilities for its owners in getting out their timber during a term of perhaps ten to fifty years. Furthermore, it is encouraging that several of the larger timber concerns now recognize this condition and realize the economic or direct money value to themselves in putting their logging railway work into the hands of engineers.

Widening the Laborer's Opportunity

ONE effective answer to the trade union closed-shop apprentice restriction is the establishment of trade schools. Aside from the many private ventures a few cities like Cincinnati have initiated public schools. Chicago has recently established one under the Citizens Committee to enforce the Landis award. The movement has grown directly out of the fight by the local unions against opening up the decidedly restrictive working rules and regulations. Basicly the union idea of restricting the number of skilled mechanics to the lowest possible number of workmen is unsound. It smacks much of the old world special privilege classes, of the caste system of India. Freedom as to choice of work and equality of opportunity is a fundamental of American life and thought.

A year ago the average young man in Chicago with an aspiration to learn one of the closed-shop trades had neither freedom as to the choice of the trade he would like to enter nor equality of opportunity. If he were the son of a carpenter he could learn the trade of a carpenter, but it was practically impossible for him to become a plumber's apprentice. This condition could not go on. The inexorable law of supply and demand has a corollary that is almost as active in operation as the law itself, viz., demand will create an ever-increasing supply until the remuneration approaches the average. For only a limited time can artificial barriers to economic laws dam the flood of public opinion and urgent necessity.

Perhaps nowhere in the country have the constitutional privileges been flaunted and these economic laws been more disregarded than in Chicago. But Chicago is on the way toward economic freedom and equal opportunity of its skilled labor through the operations of the Citizens Committee to enforce the Landis award. Judge Landis gave a new, simple and practical expression to what Americanism means. His decision as arbitrator in the controversy between the building trade unions and contractors associations largely had to do with present working conditions. Day-to-day and year-to-year practical operation of the decision has been the burden of the committee which bears the judge's name.

In the solution of the supply-demand feature the com-

mittee has borrowed men from its sister cities. At the best this is an expedient measure. A transfer of money from pocket to pocket does not make one richer. Ten million people with ever-increasing needs are added to our population every ten years. Accordingly the existing proportion of skilled mechanics must more than keep pace with the natural increase, which means that Peoria cannot lend men to Chicago permanently. Formation of trade schools open to everyone is the logical development.

The Citizens Committee has opened the first class in an intensive training of plumbing apprentices. The course as arranged will take for completion two and one-half to three years for the average youth instead of the four years under the former union conditions. Instruction is free. Each apprentice is assigned to Landis award contractor under pay after three weeks intensive training. Then he returns to the school for from four hours to one day per week. Courses in other trades are being added. The opportunity is also given for advancement by those already in the trades. Already many men in the helper class have brought up their skill to that of journeymen and a number of competent foremen have been developed from the journeymen. Naturally the men have been pleased to move ahead in their trade. The contractors have found the school has not only improved the skill but also the morale of their men. Problems of the day's work are brought up and discussed; thus defects are eliminated.

Provisions for trade schools should receive more attention from public school officials. At best citizens committees are ephemeral as to duration. Close cooperation of the schools with the contractors and ultimately with revamped, new-visioned labor unions (if any are to exist) will always be necessary to make the system a success. Unwittingly union resistance to the enforcement of the decisions of labor's own arbitrator has widened opportunity in Chicago.

Emphasize the Practical

ENGINEERS are fond of thinking and saying that the public does not appreciate them and that from this lack of recognition spring most of the ills of underpayment, that crystallized grievance of the profession. There is not perfect continuity in this reasoning, because the analogy does not hold in other lines of work. No one especially admires the straw hat wholesaler nor goes out of his way to praise the great work done by the corporation lawyer. Yet both of these men are paid a large and disproportionate wage, because each in his own way can take advantage of the economic necessities of those to whom he sells. The engineer, on the other hand, rarely has to deal with an individual or compact group of individuals over whom he can exercise this economic advantage. His customer or his client is the people because no matter with whom he deals at first hand, in the end it is the public who benefits by his work. This public, then, controls his reward, and in proportion as he has its regard will he himself profit, taking the mass of engineers and not the individual as a measure.

It follows that this growing desire to inform the people of the importance of the engineer in the world's affairs is well grounded and deserving of serious study and promotion, but in so doing one thing must be remembered: the engineer is a practical and not a romantic figure. Already the world has altogether too high an appreciation of the romantic possibilities of engineering. The application of the forces of nature to the uses of man has a great hold on the imagination. It is easiest to picture it in its outward aspects, to see only its high spots—Eads throwing the Mississippi to clean its own outlet, Marconi picking a wave out of the ether to carry the human voice, Goethals driving thirty thousand men to dig a ditch across Panama and, in its simplest terms, Kipling's Findlayson, a lonesome superman struggling far from civilization to bridge the Ganges. There is no danger of the public underestimating this phase of engineering. Next to the soldier and the fast disappearing cowboy the engineer is the most romantic figure of the times.

But the great and enduring everyday work that the engineer does in bettering the economic and physical conditions of life are not properly evaluated. Toward changing this the publicity efforts of engineering societies can well be directed. Citizens can be shown how the rearranging of traffic routes save life, how the improvement of the water supply reduces disease, how the development of a better type of paving lowers taxes—not as generalities but as specific instances in which the citizen himself is interested. Stockholders can be told how the engineering control of the business has increased profits—and if it does not when properly applied all of us who are in engineering and believe in its principles had better get into something else. In both public and private enterprises the practical must be emphasized and the khaki clad romantic left as far as possible to the scenario writer and the weekly fiction magazine.

Two weeks ago in New York State there was a good example of how great is the emotional appeal. For state engineer the Socialists ran Steinmetz, the electrical genius, a romantic figure in engineering if there ever was one. Against him the two major parties put up good engineers, each a man of experience in the administration of state office and either one superior to Dr.Steinmetz in the detail qualifications necessary in the office of state engineer. What happened? He was not elected but over 200,000 of the voters of the state of New York scratched their party tickets and voted for the man who leads the world in the knowledge of electrical transmission, not because that and his numerous other talents were desirable in the state engineer's office but because he has become, justly no doubt, the romantic embodiment of engineering genius. What the state needed before election was some good publicity as to just what the state engineer had to do, what were the qualifications of each of the candidates and how much more important for this particular job were qualities of what might be called average engineering ability than exceptional genius which can be used to greater advantage where it is now occupied.

In hammering on the practicalities of engineering there may be danger of setting up in the mind of the public a cold dollar-and-cents individual who has no vision beyond the immediate material job in hand. That would be a misfortune which can be avoided by proper publicity methods, but even such a figure is better to present than the adventurer, whom the world may love but not necessarily reward, or the superman, who is both respected and rewarded but who in real life is rare and therefore untrue as a representative engineer.

Building Concrete Bridge Around An Old Steel Bridge

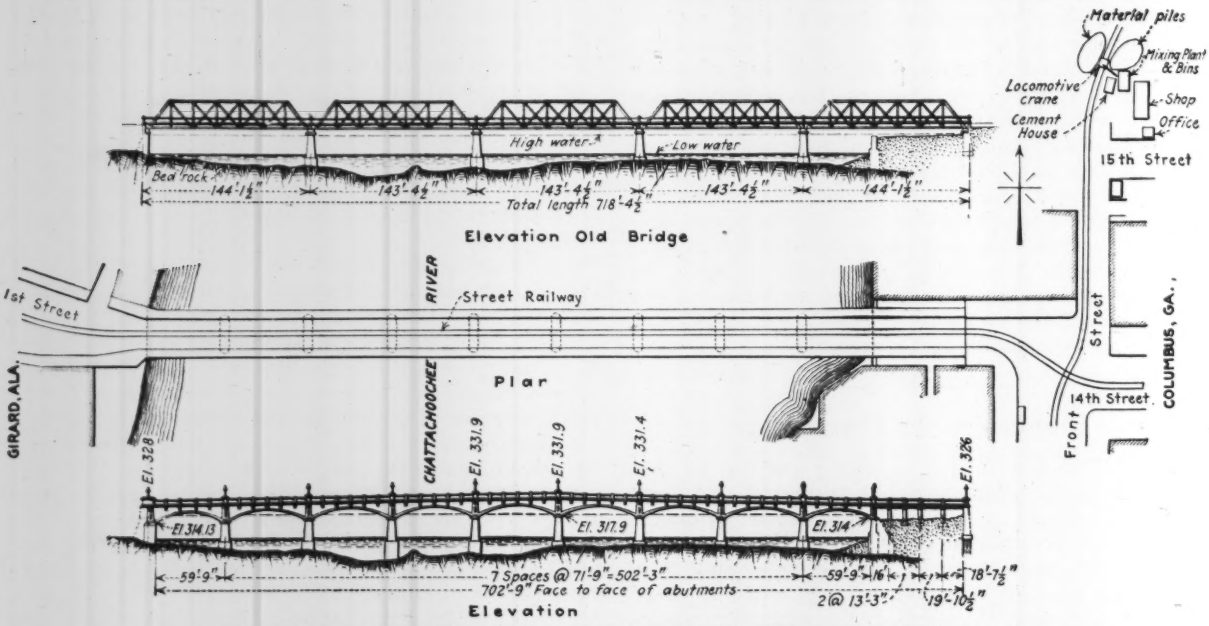
Old Piers Utilized and New Ones Placed Midway of Old Spans in Bridge Across Chattahoochee River in Georgia—Steel Trusses in Service During Construction

By Searcy B. Slack
Bridge Engineer, State Highway Department, Atlanta, Ga.

IN THE construction of a new concrete arch bridge replacing an old steel bridge over the Chattahoochee River at Fourteenth St., for the city of Columbus, Ga., there were two main problems: first, the utilization of the old bridge (substructure and superstructure) to best advantage and second, the minimum inconvenience to the heavy foot and wheel traffic which uses this bridge. The bridge connects Columbus with Phœnix City and Girard, Ala. The solution involved the construction of the concrete arches under the trusses and the utilization of the old piers.

The old bridge consisted of five 140-ft. through Pratt, pin-connected trusses with a 24-ft. roadway and two 6-ft. sidewalks. The bridge had a wood floor and originally carried a street car line but of recent years, due to bad condition of floor system, street cars have not used the bridge. The substructure consisted of four concrete piers with round ends 6 ft. by 27 ft. 6 in. under coping and gravity type concrete abutments. All the piers and the west abutment are founded on solid rock (gneiss). The east abutment is on piling. Between the east abutment and the first pier the bridge extends 62 ft. between two cotton factories before reaching the river bank. The factories are connected by a walkway under the bridge and a large number of pipes, wires, etc., and one of the requirements of the new bridge was to provide as much space as possible underneath this approach for use by the factories. The old bridge was built in 1901 and a careful inspection of the concrete piers showed them to be of good material and in excellent condition. The trusses of the old bridge were in fair condition but the floor system was very much weakened by corrosion of the steel.

Several alternate plans were considered before finally deciding upon the filled spandrel arches. One of these alternates contemplated the use of through concrete arches with bottom chords, the arches to be built just outside of the old steel trusses as the centering for the arches supported by the trusses. This plan was abandoned as the roadway would have been made 2 ft. 6 in. narrower and sufficient room was not provided on top of the old piers for proper detailing at the ends of the arches. The plan adopted required the construction of four new piers between the old piers and the counterforting of a concrete retaining wall between the cotton factories so that it would serve as the east abutment. Between the new piers and the old piers nine filled spandrel barrel arches were built and a slab approach supported by column bents connected the east abutment and the improvised abutment pier. The west abutment was strengthened by adding a new concrete wall in front of the old abutment.



OLD AND NEW BRIDGES ACROSS CHATTAHOOCHEE RIVER, COLUMBUS, GA.

The suggested method of construction set forth in the specifications was as follows: "In the opinion of the engineers the logical method of construction of this bridge is as follows: Cofferdams be constructed for piers "D," "F," "H," and "J"; these cofferdams to be floated in place and the piers erected therein, placing concrete through floor of the existing bridge; abutment "B" be constructed; bents Nos. 1 to 5 be constructed; additional concrete for abutment "K" be placed."

"The existing steel spans can be raised so that the bottom flanges of the floorbeams will clear sidewalk elevations of the new bridge. These spans can be raised by cribbing on top of the present piers and after proper height has been reached shoring from the bases of the

existing piers to the bottom of the shoes of the spans leaving no crib work on top of the old piers. By raising the spans in lifts successively traffic can be maintained during this operation. After the old spans have been raised the existing piers can be cut off to the proper elevations and new caps placed. Centering for the arches can be planned so as to be supported from the floorbeams of the old spans. The centering for the arches can be placed and the arches concreted through the floor of the old bridge. After the centering has been removed the spandrel walls can be built, omitting sidewalks; spandrel fills can then be made and the old bridge removed, traffic being permitted on the spandrel fill of the new bridge. The sidewalks can be constructed and one-half of the brick pavement laid, traffic

ARCH BRIDGE UNDER CONSTRUCTION BENEATH THE OLD TRUSS BRIDGE

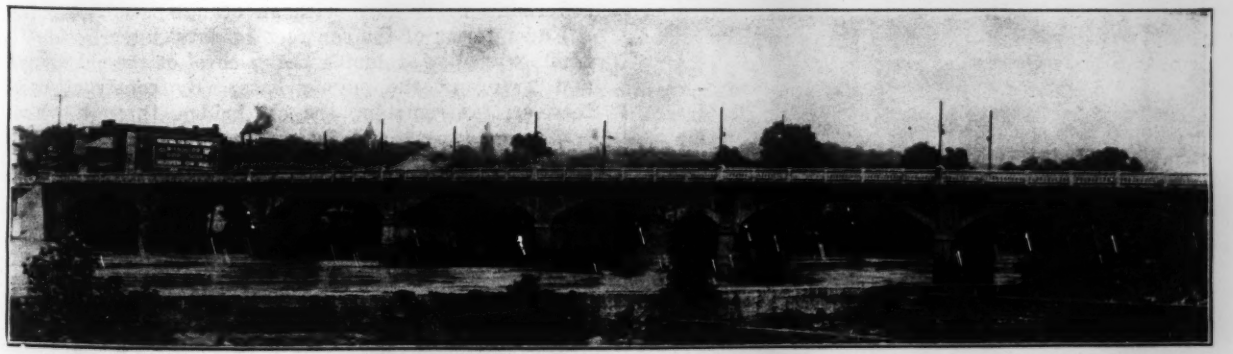
can then be diverted from the spandrel fill to the new pavement, and the bridge can be completed. The east approach span can be constructed beneath the old bridge, the first span of the old bridge being raised to sufficient height to clear the new slabs, traffic being handled to the old span by means of a short runway on grade not exceeding eight per cent."

In the actual construction this method was carried out as outlined except placing bents against old piers to support the steel trusses while the piers were being cut off and capped for the arches. The method used was more satisfactory as it did not require placing bents against the piers. The central portion of the piers (about 20 ft. long) between the shoes of the steel trusses was cut down to the proper elevation and the middle 18 ft. of the new cap and arch skewbacks poured. The old piers were cut down by drilling holes in from both sides with compressed-air drills. The holes were from 6 to 12-in. centers depending upon the accuracy of cut desired. The holes were feathered and wedges were driven splitting the concrete out in blocks. After a little practice the crew became very expert and the necessary cuts were made with ease and surprising accuracy. Cutting out concrete from one of the old piers is shown in one of the accompanying illustrations.

After the central portion of the new pier caps and skewback had set, lifting beams, consisting of two 24-in. I-beams 29 ft. long connected by plates, were cribbed up on the new concrete work. The beams were so placed that they overhung the shoes of the two adjacent trusses. Holes were burned through the cover-plates of the end posts and straps were passed around the end pins of the trusses and over the lifting beams. Four 75-ton hydraulic jacks were then placed and lifting the old bridge began. It was necessary to raise the bridge 8 ft. 6 in. at the center and 4 ft. at each end so that the floorbeams of the old bridge would clear the extrados of the new arches at the crown.

Traffic was maintained over the central part of the bridge and both sidewalks during the lifting, runways provided at each end being shifted as the trusses were lifted. After the lifting was finished the lifting beams were cribbed up on the new concrete skewback, leaving the ends of the piers clear so that the old concrete could be cut down and the new cap and skewback for the arch ribs completed. The new bridge required a counterfort at the ends of the piers bracing the spandrel walls. At the ends of the old piers contractors enlarged these counterforts somewhat and poured them up to a suitable height to carry the old trusses. As soon as the concrete had set, the trusses were lowered until the shoes rested on the counterforts and the lifting beams and cribbing were removed to be reused.

After the old steel spans had been raised and set on the counterforts, centering for the arch rings was constructed under the old spans. The centering was

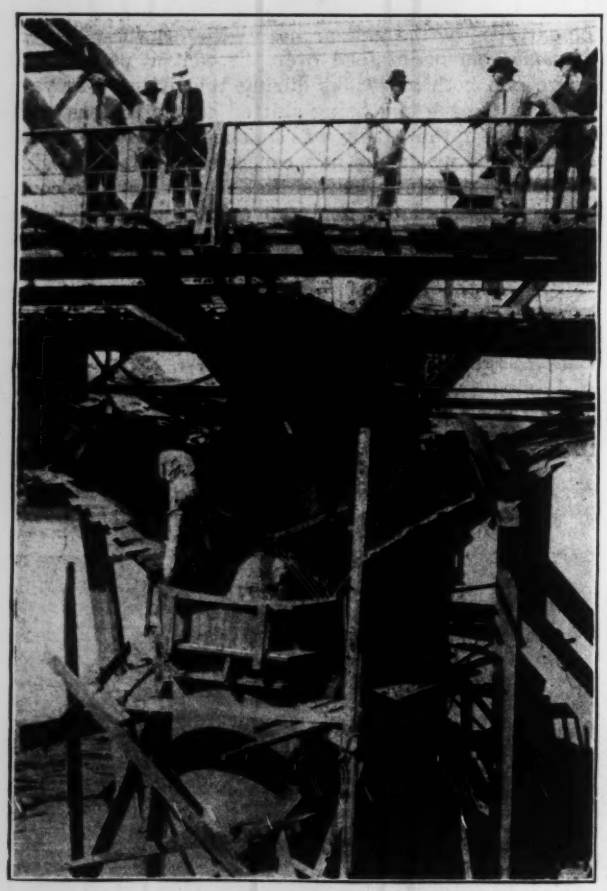


THE COMPLETED NEW ARCH BRIDGE

supported by fastening rods to the floorbeams of the old trusses. These rods were wrapped with tar paper where they passed through the concrete arch ring so that they could be withdrawn as soon as the arch rings had set. To prevent overloading the old trusses the arch barrels were poured in three sections each 9 ft. wide. The downstream sections were poured first from abutment "B" entirely across to abutment "K." As rapidly as these sections set the centering was released and set for the upstream section. As soon as the upstream sections had set the centering was released and the center section poured, completing the arch barrels.

Forms for the spandrel walls, cross walls and sidewalk brackets were constructed between the arch barrels and the old trusses and this portion of the new bridge was completed. The spandrel fill was made by dumping through the floor of the bridge. A rather coarse sand with a small amount of loam was used for this fill and the material was wet down in layers as it was placed. The stone drains along the backs of the spandrel walls proved very effective in carrying off the water used for packing the sand. When the spandrel fill was completed the floorbeams of the old bridge were blocked up on the fill and the old trusses were taken down. The spandrel fill was then made up to the level of the floor system and the floorbeams were removed, the floor and stringers resting directly on the sand fill.

The old floor was cut, leaving a width of from 12 to



TURNING TRUSS PIER INTO ARCH PIER

INTERMEDIATE PIERS BEING PLACED

15 ft. directly against the upstream side of the bridge and a 9 ft. strip of the concrete paving base was poured between the edge of the old floor and the downstream curb. After this paving base had set, traffic was diverted from the floor of the old bridge to the 9 ft. base, the old flooring was removed and after setting street-car tracks the paving base was completed. The vitrified brick paving was placed from the upstream street-car track to the upstream curb and as soon as completed traffic diverted from the downstream concrete paving base to the finished brick paving and the remainder of the brick surfacing was completed. An asphaltic filler was used in making the brick pavement.

Construction Methods—The equipment and methods used by the contractors were very well planned. All materials were delivered by rail to a yard about 500 ft. from the east end of the bridge where they were unloaded and stored by a crane. The same crane used for unloading was also used to fill the material hoppers of the central mixing plant. All concrete was mixed at this plant and hauled to the bridge in trucks with dump bodies and handled by chutes from the truck bodies to the forms through trap doors and holes in the floor of the old bridge. In spite of the heavy traffic over the bridge, which greatly hampered the concrete trucks, as much as 100 cu.yd. of concrete was frequently handled in a day.

All drilling was done by air which was furnished by a compressor located near the east end of the bridge. Electric power was also available for lights, pumping, etc. A woodworking shop equipped with a band saw, cutoff saw, planer drill press, etc., driven by electric motor was set up near the material yard and all necessary wood work for the frame was done here. Work in the river was done from a barge equipped with hoisting engine and stiff-leg derrick, dredging in the cofferdams being done with an orange-peel bucket.

Under terms of the contract 14 days' interruption to traffic was allowed during the removal of the old bridge and laying of the paving base. By constructing a traveler, for removing the old bridge, through which traffic could pass and by cutting the floor so as to permit laying the paving base in sections, the contractors maintained traffic with only a few hours' interruption during the entire construction.

This work was done by Hardaway Contracting Co. for the city of Columbus, Ga. B. H. Hardaway, Jr., and Guy Jones were in charge for the contractors. George Hardaway was engineer for the contractors. Garrett & Slack were consulting and designing engineers.

A Low-Head Hydro-Electric Plant of 84,000 Hp. in Norway

Development Illustrative of Modern European Practice Involves Large Roller Dam and Novel Timber Chute

By W. Francis Lloyd
London, England

RECENT European practice in the design of low-head hydro-electric plants is well illustrated in the new 84,000-hp. development recently completed at Raanaasfos, on the river Glommen, 50 miles from Kristiania, Norway. The scheme presents many unique features which are of particular interest. In consequence of several other water-power developments on the same river, the total daily discharge of the river at Raanaasfos is guaranteed at a certain amount—varying with the time of the year. To provide for the guaranteed daily discharge and also for the best available head in the various seasons, it is necessary to use a roller dam and two sector dams, by the manipulation of which it is possible to adjust the head and discharge to a nicety.

Timber Chute—Owing to the enormous quantity of timber passing down the river the government required the power company to construct a timber chute to provide an adequate passage for the timber in the low water period. The chute is designed to deal with about 180,000 logs a day, the necessary water amounting to from 15 to 30 cu.m. per sec. The chute is 800 m. long, 200 m. of it taking the form of a tunnel, the remaining portion being an open concrete canal.

The section of the tunnel is trapezoidal to secure a large area for the logs with the minimum loss of water.

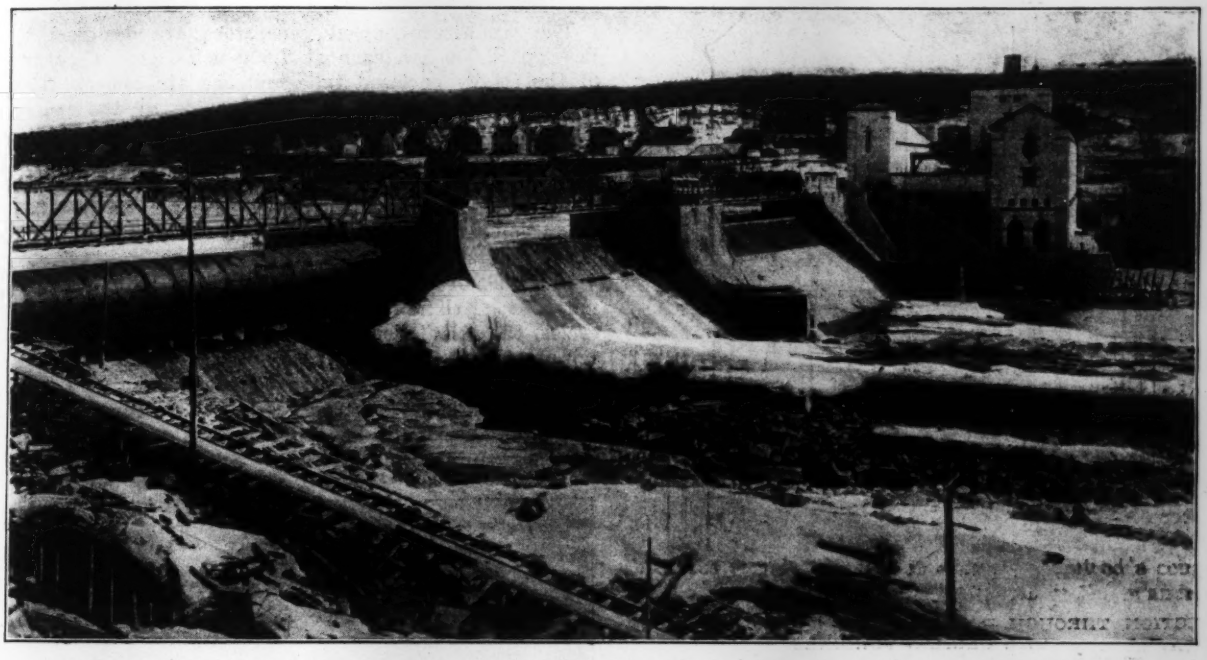
The cross-sectional area and gradient are designed to give the water an ever-increasing speed, thereby eliminating the possibility of the logs jamming. Booms of steel construction are laid across the river to divert the timber toward the chute.

The intake is provided with a sluice gate, in front of which is laid an adjustable bottom plate which regulates the water supply to the chute.

The Dam—The dam comprises a spillway, discharge sluice gates, two sector dams and a roller dam.

The spillway is designed for discharging masses of ice which accumulate in winter above the power station intake. The spillway is 3 m. long and is provided with a sluice gate which may be quickly opened and closed to get rid of the ice blocks.

Surplus water is discharged through six sluice gates situated at the bottom of the dam, each 2 m. wide by 4 m. high. These gates were designed to discharge sufficient water to facilitate work on the foundations of the dam and turbine intake during construction.



LOOKING ACROSS THE DAM TO THE POWER HOUSE IN NEW RAANAASFOS DEVELOPMENT IN NORWAY
Roller dam in foreground has 21.3 ft. diameter. View taken in April and shows late ice conditions.

The gate hoisting gear may be controlled either by electricity or by hand.

The sector dams—which are a new departure for Norway—are each 50 m. long and are capable of regulating the head to an extent of 3.75 m. They can be opened or closed in 10 min. When completely closed, opening is facilitated by the injection of compressed air into the interior of the sectors. Thawing out, in the winter, is effected by steam supplied by a boiler accommodated in the middle pier.

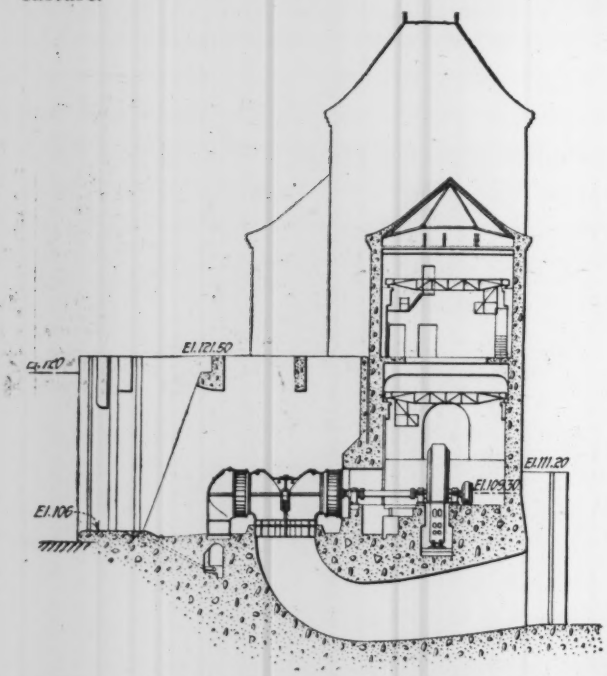
The roller dam, seen on the left in the above view, is 45 m. long, the diameter of the cylinder is 6.5 m. and the weight 500 tons. It can be lifted to the full open position in 65 min. by a 50-hp. motor working through a gearing of 4,200:1, the largest gear wheel weighing 10 tons. The operating gear at the ends of the cylinder is heated electrically to insure operation in the most severe frost.

The roller dam is capable of adjusting the head to an extent of 6.5 m.

Power Station—The power station is built on an ex-

tension of the dam on the left bank of the river. The turbine pits consist of six open flumes in which the turbines gates and trash racks are installed. During the winter the racks are electrically heated to prevent ice formation. The gate operating machinery is housed in a special building which is heated by hot air from the generators.

The six turbines are of the horizontal, twin runner, Francis type, each capable of developing 12,500 hp. at 13 m. head or 14,000 hp. at 14 m. head. The speed is 107 r.p.m. corresponding to a specific speed of 388 metric units. The diameter of the runners is 3.5 m. and the guaranteed efficiency 85 per cent. Three of the turbines are of Swedish and three of German manufacture.



SECTION THROUGH POWER HOUSE SHOWING ONE OF THE GERMAN TURBINES

A great point of difference of design between the German and Swedish turbines lies in the arrangements for supporting the main shaft. The Swedish turbines have no middle bearings, the shafts being of hollow design and of sufficiently large diameter to keep the maximum deflection within the prescribed limits. Such an arrangement eliminates the heavy cost of the middle bearing with the consequent necessity of providing an inspection shaft.

The drawing shown gives the general arrangement of one of the German turbines directly coupled to the generator. A section of the plate steel inspection shaft to the middle bearing is indicated in this drawing. This shaft runs down from the bearing at an angle of about 45 deg. to meet the communication tunnel running out from the generator room below ground.

The governing arrangements of all the turbines are of the automatic oil pressure double servomotor type, the oil being supplied under pressure by separate oil accumulators. The regulating movement is communicated to the guide vanes in the usual way by means of a horizontal regulating shaft supported by bearings on the turbine casing.

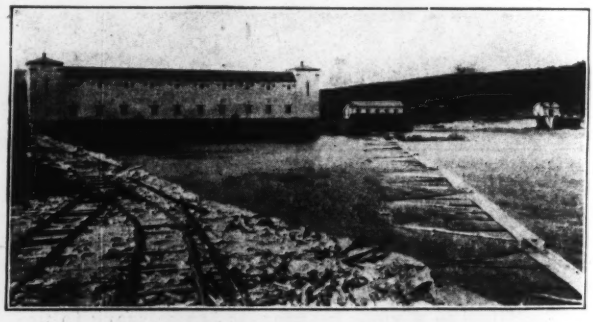
LOOKING UPSTREAM TOWARD THE PLANT
Trapezoidal concrete timber flume shown at left foreground.

The six direct-coupled generators are designed to develop 12,000 kw. each at 7,500 volts a.c. They are of the totally enclosed type and are air cooled. The air is drawn from the tail race side of the power station and driven through the generator coils by vanes fixed on the rotors. The discharged hot air is led through ducts to the sluice gate house.

An auxiliary 250 hp. hydro-electric unit is installed at one end of the generator room, for excitation purposes and station service.

The bulk of the power station output will be transmitted to Kristiania at 50,000 volts, three-phase, 50 cycles, the remainder supplying the surrounding country at a line voltage of 17,000.

Work on this scheme was commenced in 1919, and the chief engineer in charge of the whole construction, August Paus, is to be congratulated on having the turbines running according to schedule, in spite of many unforeseen difficulties. The total cost of the development is estimated at Kr. 40,000,000 which is equivalent to Kr. 476 per maximum horse-power.



LOOKING DOWNSTREAM TOWARD POWER HOUSE
Timber boom in right foreground and bridge over dam at right background.

Weight and Cost of Rondout Creek Bridge

Supplementing the information on the 705-ft. suspension bridge over Rondout Creek at Kingston, N. Y., given in our issue of Sept. 14, p. 424, the following figures on cost, weight and capacity can be given: The total cost of the structure is about $700,000. The design loading is a continuous line of 15-ton motor trucks in both directions, which represents the heaviest trunk-line highway traffic. The cables and suspenders weigh 300 tons, and the structural steel of towers, trusses and floor system 1,430 tons.

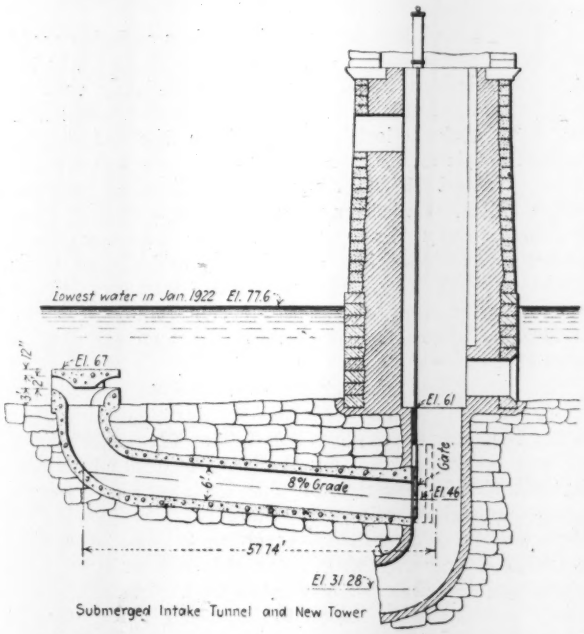
Auxiliary Submerged Intake Alongside Tower

Experiments with Model of New St. Louis Water Tower Indicate Sand and Ice Must Be Handled by Different Means

By C. M. Daily
Engineer in Charge, Supply and Purifying Section, Water Division, St. Louis, Mo.

FROM an experimental model of the new St. Louis water tower it has been concluded that the best arrangement is to have a submerged intake alongside for use only in the winter to prevent the entry of ice. Permanent nose pieces or deflectors will not effectively keep out both ice and sand.

The water supply for the St. Louis water department has been taken from the Mississippi River for nearly 100 years and for more than one-half of that period was drawn through intake towers located in the channel. The Bissell's Point intake tower, which was built about 1870 and abandoned in 1895, was located close to

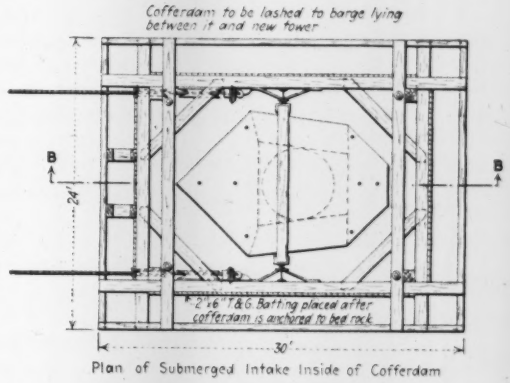


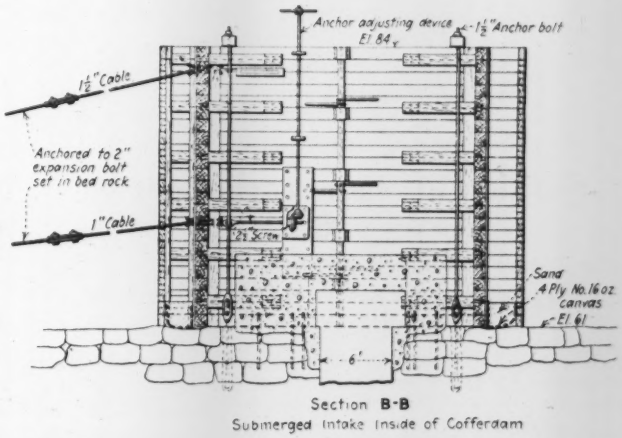
Submerged Intake Tunnel and New Tower

shore in the channel. Our files show that various ice booms, ice deflectors and other devices were designed and built to prevent ice from entering its ports. The old tower at the Chain of Rocks was built in 1894 and has to its credit many such devices designed and built for the same purpose. All of these expedients were more or less unsuccessful, due to the varying direction and velocity of the current when carrying large quantities of ice. The latest and perhaps the most successful measure undertaken for the purpose was the rebuilding of Homer's Dike, which caused a cross-current to deflect the main ice-bearing current away from the tower.

The new tower, which was built at the Chain of Rocks in 1915, has lower ports than the old one, but it has been less effective in excluding the ice, due unquestionably to its location closer to the center of the channel, in a stronger current, where more ice strikes the tower and is crushed by the impact into small particles, which are carried by the swirls and eddy current to the bottom of the river and into the ports.

Over a year ago an experimental intake tower and tunnel were constructed on a 1/30 scale of the new tower and various experiments were conducted with floating ice at velocities equal to the velocity in the river multiplied by 18/100. $\left(\frac{1}{\sqrt{30}}\right)$. The water was maintained at a depth corresponding to the depth


Cofferdam to be lashed to barge lying between it and new tower
B
B
24'
2"x6" T&G Bottling placed after cofferdam is anchored to bed rock
30'
Plan of Submerged Intake Inside of Cofferdam



Section B-B
Submerged Intake Inside of Cofferdam

SUBMERGED INTAKE FOR USE IN WINTER TO PREVENT ENTRY OF ICE

of the river during low stages in winter. It was found that the eddy currents carried the ice to the bottom of the model channel and into the ports. Various deflectors were placed in front of and behind the tower; it was found that when the deflector did not cause the water to pile up ahead of the tower no ice was carried below the surface.

In connection with the model tower several submerged intakes were placed close to the tower and determinations were made of the amount of floating ice which would enter them, also of the amount of sand which would enter when sand bars of various heights passed. The results of the experiments are given in the Water Commissioner's annual report of last year as follows:

The model nose piece or deflector in front of the tower, while efficient for preventing ice from entering, is very inefficient in preventing the sand from entering the gates when a bar of any height is passing.

The submerged intakes are efficient for preventing the ice from entering the tower and also for preventing the sand from entering when a low bar, under 3 ft., is passing.

When a bar of more than 3 ft. in depth is passing a great deal of sand will enter.

The tower as designed is very efficient in preventing sand from entering the tunnel when a low bar is passing, but with a high sand bar, say over 4 ft., sand and gravel will be lifted to any of the higher gates by the eddy caused by the sharp nose piece.

It is very evident that if ice is allowed to pass undisturbed little will be drawn into a port a few feet below the surface, but if the port is on the side of a tower at the bottom of the river a blunt nose piece is necessary to cause a side current to force the sand from the side of the tower. In consequence it is impossible to place any sort of a permanent deflector ahead of the new tower to meet both conditions. The two conditions must be met separately. A submerged intake, as shown in the illustration, is suggested as a solution for the ice troubles. It is intended to use the submerged intake only during the winter months, keeping it closed the remainder of the year. The accumulation of sand during the summer months in the short tunnel from the submerged intake to the down-take shaft will be easily washed into the main tunnel and carried to the pumps each winter without any difficulty.

The tunnel work may be done from the down-take shaft and the gate erected before breaking through the outer end within the cofferdam previously anchored in place. An air-lift pump on shore, of more than 5-m.g.d. capacity, will care for the leakage.

It is estimated that the cost of this work under the most adverse river conditions will not exceed $40,000 and that under favorable river conditions the cost may be only $30,000.

Seattle Fills Land with Garbage, Ashes and Refuse

For Thirty Cents a Ton Sanitary Fills Are Being Made at Sixteen Points Within City Limits —Three Destructors Scrapped

FOR about seven years Seattle, Wash., has been disposing of its garbage, ashes, and other refuse within the city limits by the "sanitary fill" method—that is, by dumping it on low land and covering it with earth. The earth covering is only a few inches deep and is but a small percentage of the total volume of the fill which may be as much as 18 or 20 ft. deep. In contrast to popular objection that was at first raised to this method of disposal, it has now been demonstrated that these fills can be made so as to be entirely free from nuisance. The present attitude of the people of Seattle is shown by the fact that the Health Department has on file continually a waiting list of property owners who desire to have lots filled by this method.

The development of the sanitary fill is held by the Seattle authorities to be cheaper and more satisfactory than incineration. The use of Meldrum destructors (a British type) was discontinued, city officials state, on account of the high cost of operation. These were all duplicate installations, each having a capacity of 65 tons per 24 hours. The first was built in 1908 and was used five years; the second and third units, built in 1911 and 1912 respectively, were each used for three years. These destructors are reported to have been very effective, the only objection being cost of operation.

Records kept by the engineering department give costs that average about 60 cents per ton, exclusive of depreciation, interest on the investment, or other overhead charges. The actual total cost, in the opinion of city officials, was about $1 per ton. At that time the average wage paid men working at the destructor was only $3 per day. Under present conditions it is estimated that the cost per ton would be about double the previous figures.

One of the three destructors was retained by the city for some time as a place to burn paper and other waste material of an inflammable nature but since 1915 individuals have been allowed to pick paper, cardboard, etc., from the fills and they also assist the city to some degree by sorting out other inflammable material. All three destructors have therefore been disposed of. One of the buildings was razed, a second remodeled for a carpenter shop, and a third leased for storage purposes.

In contrast to disposal by incineration the cost of making the sanitary fills, exclusive of delivery costs, is about 30 cents per ton, or less than one-third the cost of incineration as practiced at Seattle a few years ago. The 30-cent charge includes no allowance for the increased value of filled land. Dwellings have been built on sanitary fills 20 ft. deep.

Collection and Delivery—Delivery is now being made to sixteen fills widely distributed over the city. This wide distribution materially reduces delivery cost by shortening the haul. A total of ninety-three teams with two men each collect garbage from the entire city (except hotels and restaurants) which now has a population of about 315,000 and covers an area of about 66 square miles. Collections are made once a week from dwellings, every three or four days from apartment houses on the outskirts of the city, and six or seven times per week, as required by sanitary conditions and freedom from alley obstruction, from factories, docks, department stores and throughout the business district generally.

The hotels and restaurants have contracts with the owners of a hog ranch who take all garbage from these places that can be used as hog food. The collection of garbage and refuse by the city is made without charge, the cost of this service being met by taxation. In making the household collections there is no restriction on what will be accepted. Everything classed as refuse is included and anything from old bath tubs to tree trimmings is taken without objection. In fact, "garbage" in Seattle is taken to include kitchen wastes, ashes, tree prunings, boxes and other packing materials discarded by department stores, commission houses and factories. Practically everything wasted in the city except sewage and the debris from buildings that are razed, is accepted by the scavengers.

Sites preferred for garbage disposal under the present plan are areas where a fill 10 to 14 ft. deep can be made adjoining paved streets. As a new fill is started it is brought up to the desired level and then maintained at that level by dumping the garbage over the edge of the fill instead of on top of it. As fast as the area of the finished level is extended it is covered with a few inches of sand, and planks are laid as a runway for the garbage wagons.

Loads of sand or other material used for covering the garbage are delivered on top of the fill at the point where the garbage wagons dump over the edge. One attendant paid at the rate of $5 a day is kept on each fill. He shovels earth over the edge as required to cover

the freshly dumped garbage, rakes some of the garbage down the dump to get the desired arrangement, and does a limited amount of sorting and piling up wooden boxes and other objects of a large size at the foot of the dump.

Method of Filling and Covering—The covering is done as soon after dumping as is consistent with the separation of material that can be burned readily. The picking over is done largely by persons who come for the paper and cardboard they can glean from the piles. This salvage nets them about $3 per day and as they aid in clearing the material that can be burned, it has been found cheaper for the city to allow them to salvage this material for their own benefit than to have it removed at the prevailing laborer's wage. Boxes and other bulky objects that will burn are piled up near the foot of the dump and the attendant occasionally sets fire to these piles.

Garbage delivered at a fill recently visited by a representative of this journal amounted to an average of twelve wagon loads a day or about 96 cu.yd. This was adequately covered by 8 cu.yd. of sand per day, spread on as the garbage was dumped over a 12-ft. embankment. This was in August when there were practically no ashes in the garbage. During winter months, when seventy or eighty tons of ashes are collected daily, some of the fills are entirely covered with the ashes without requiring any filling material brought in expressly for the purpose. The total amount of garbage now collected daily by the city varies from 400 tons in summer to about 500 tons in winter.

The sand or other material for the covering is delivered by two teams which do nothing else and two trucks which devote part of their time to this work. Thus far it has never been necessary to excavate material expressly for this purpose or to haul it for distances greater than about 1½ miles. Usually suitable covering material is available close to the garbage fill. Often this comes from public or private grading or excavating operations. A large supply of waste is taken regularly from a gravel washing plant which is conveniently located. Often the department has on file applications for the disposal of more material than can be utilized for covering.

Experience has taught the men that the best means of making an effective fill is to work the wet material or "garbage" proper down to the bottom of the dump slope and then get the dry, coarser refuse over it. After the sand covering is shoveled on, which is done immediately from piles kept at the edge of the dump for that purpose, there is practically no offensive odor or gathering of flies. As the top of the fill is kept level and is covered with earth, it has the same appearance as any fill made entirely of earth and only the outer end of the dump at the time of dumping betrays the true nature of the fill.

Fills 10 to 14 ft. in depth increase in area rather slowly and are compacted to some extent by the wagons that drive over them daily. After several years of experience it is asserted that these fills do not settle much more than a fill made entirely of earth and they are approved by the city building department as suitable foundation for light structures.

Garbage disposal operations in Seattle are carried on by the Health Department under the direction of C. L. Murray, superintendent, who supplied the data on which the foregoing notes are based.

Foundation Excavation Removed by Tunnels at Chicago

Shafts on Building Site Chute Material to Cars of Narrow-Gage Underground Railway for Disposal on Lake Front

REMOVAL of excavated material from building sites by tunnel trains and thus eliminating much truck haulage and dropping of dirt in crowded city streets is an unusual method which has been in operation in Chicago for several years. This method is made practicable by utilizing the network of 62 miles of small tunnels which underlies the central portion of the city and carries an electrically-operated freight railway system of 2-ft. gage. These concrete-lined tunnels are

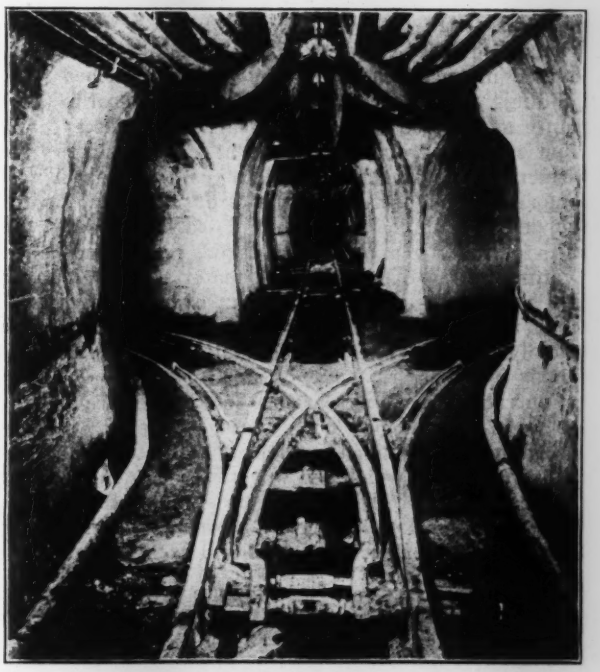


FIG. 1. NARROW-GAGE TUNNEL HANDLING FREIGHT AND EXCAVATED MATERIAL AT CHICAGO

There are two intersecting tangent tunnels at this point, connected by four junction curves.

of oval section about 7½ ft. high and 6 ft. wide, with the rail level approximately 45 ft. below the surface. One of the numerous intersections of the east-west and north-south lines is shown in Fig. 1.

In deep foundation work and in excavations for basements and sub-basements of large buildings it is common practice to sink an inclined shaft or chute to the tunnel under the site, the tunnel being enlarged or having a spur built for a siding to enable a car to be set under the chute. The upper end of such a shaft is shown in Fig. 2. Surface dirt is excavated usually by steam shovels and removed by motor trucks owing to the rapidity and cheapness of making the excavation and removing the loose materials. But for the slower work of excavating and handling the underlying stiff clay the tunnel system has many advantages. In wrecking old buildings in the business district much of the débris is removed by the tunnel cars.

This tunnel system was built particularly for freight handling service and connects numerous railway freight

stations with commercial houses, department stores, warehouses and office buildings. Spurs are run into the basements and at freighthouses the cars are raised to the surface in order to avoid handling the freight to and from elevators.

For waste material there is a disposal plant or dump on the lake front near Sixteenth St. where the cars are raised in shafts and hauled to the dump by gasoline locomotives. Cars for this service have removable bodies with hinged bottoms, the bodies being handled by a locomotive crane and a fixed derrick at the dump. The latter is shown in Fig. 3. In the past eight years about 1,500,000 cu.yd. of ashes and excavated material have been deposited at that site, filling about fifteen acres of land for the new lake-front park without any expense to the city. This filling was described in *Engineering News* of April 6, 1916, p. 658, and the work is still in progress.

Tunnel traffic averages about 10,000 cu.yd. of excavated material monthly, 7,500 cu.yd. of ashes from buildings and power plants, 4,000 cu.yd. of coal to these plants and 45,000 tons of merchandise handled to and from railway freighthouses. The coal business was formerly much larger but of late years the larger coal companies have maintained fleets of motor trucks for the delivery of coal. Cars of 3½-cu.yd. capacity are used for hauling excavated material, refuse and ashes. Trains of 6 to 8 cars of such material and 12 to 15 cars of freight are handled at an average speed of 8 m.p.h. by electric locomotives, of which 110 are now in daily service. The average haul to the disposal station is 2½ miles.

Contractors make agreements for this service on each job at a charge per cubic yard, the price varying according to the haul, the quantity of material and the conditions under which the work is to be done. These charges are about the same as those made for wagons or motor trucks, since all this business is competitive. The entire movement of motors and cars in the tunnel is under the direction of a dispatcher who is continuously receiving telephone reports of business available for movement and the motors available for use. In freight service, when a motorman finishes with a train he is instructed by the dispatcher where to pick up another train. The handling of excavated material and ashes is largely a schedule proposition, the motormen reporting to the dispatcher at the end of each trip. This tunnel system is owned and operated by the Chicago Tunnel Co.

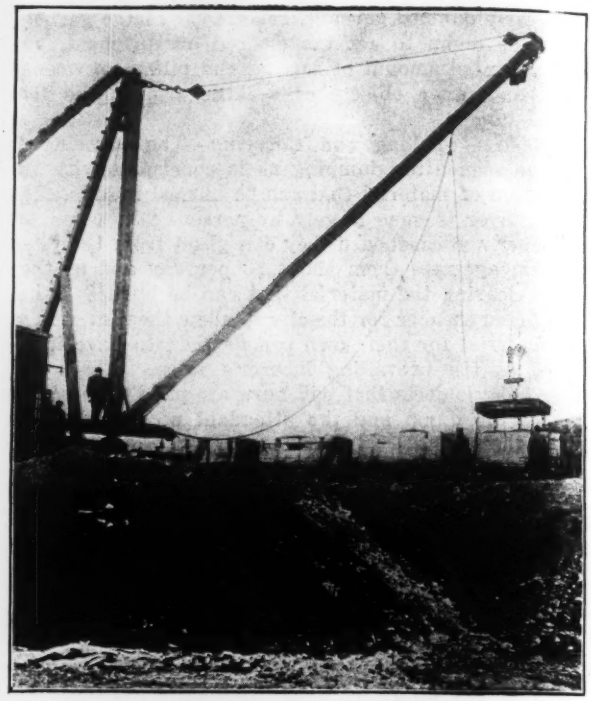


FIG. 3. DUMPING CARS AT FILL

FIG. 2. CHUTE FOR DUMPING INTO TUNNEL CARS
Chute is marked by white cross. The vertical shafts are for foundation piers.

Tastes and Odors from Chlorine

TASTES and odors of water as affected by chlorine applications arising from conditions created by modern factory practice and habits of domestic life have been studied in the laboratory at the Iowa State University. Dr. Edward Bartow and R. M. Warren reported recently the conclusions of their experiments as follows before the Iowa section of the American Water Works Association:

Chlorinated water may have a taste other than that given by excess chlorine.

Taste and odor may be developed by other oxidizing agents than chlorine, and they generally increase with the amount of chlorine absorbed.

By further oxidation aeration may increase rather than remove taste.

The oxygen-consumed method of control is good only when taste and odor are due only to excess chlorine.

Water should have access to air to give a chance for odors developed to escape.

For any given water there is an oxygen-consumed value about which chlorine will give taste and odor. When this limit is reached some method of oxidation should be used before sedimentation and filtration, so as to give an opportunity for dissipation of taste and odor during treatment, before final chlorination.

The colorimetric method is not accurate if the water contains any appreciable amount of phenol or cresol.

Logging Railway Practice in the Northwestern Forests

Engineering Skill Made Necessary by Economic Conditions—Large Projects—Methods of Location, Construction and Operation

IN planning logging railway systems for the development of large timber properties, governing economic and operating conditions are involved which differ in many respects from those which govern ordinary railway work. For example, the lines are comparatively temporary, serving for periods of perhaps five to fifty years; the loaded traffic is all in one direction, and the value of the line decreases steadily as the timber is got out and the total traffic to be handled grows less. The traffic also decreases with the increase in distance from the shipping terminal. In location, property lines

FIG. 1. EARTH CUT IN TIMBERED LAND ON RUTLEDGE LOGGING RAILWAY

become an important factor, since a logging railway is usually not a common carrier and cannot condemn land for right-of-way. Therefore, unless the railway can be kept within the boundaries of the timber company it may be compelled to pay high prices for right-of-way across other property.

On the other hand, the fundamental principles of railway location remain the same. Thus, it is essential to have the main line as direct as possible, on the minimum economic grades, passing as nearly as possible through the center of gravity of the prospective tonnage and with grades descending in the direction of the tonnage. Branches must leave the main line as soon as possible in order to develop the area served. Their grades may be steeper than those of the main line but always, or as far as possible, descending with the loads. The cost of these branches must be proportionate to their total anticipated tonnage. For logging lines the total tonnage is known in advance as the amount of timber in the areas served has been determined. But for ordinary new railways the prospective tonnage is largely an assumption based on many factors, some of which are beyond the control of the railway company.

Engineering in Logging Work—Engineering skill is now applied more than formerly in the planning of logging operations, since the days are past for easy logging along streams or by crudely constructed railways laid out as the work proceeds. The large bodies of timber remaining in the Northwest are high up in the mountains, involving heavy and expensive railway construction for means of access, but as the prices of timber increase it becomes economically practicable to build these lines. For large logging projects, therefore, careful study and detailed plans must be made before development is undertaken. For the locating engineer, the economic location of lines in heavily timbered country is no easy task.

Many of the large timber companies now plan the development of their properties far in advance of requirements, so that when the project is commenced every move made is based upon the relation of that move to the general comprehensive scheme. This detailed advance study may bring to light unsuspected possibilities that would be overlooked in a general inspection. It may also develop unexpected difficulties, with the result that special methods may be prepared to overcome them, thus avoiding losses which might occur if these difficulties were discovered only during the progress of the work.

Certain and continuous transport of the timber is demanded by the amount of capital invested in logging operations and timber mills, and such transport is considered to be provided in the highest degree by railway communication. But to extend railway lines to the tops of mountain ranges involves difficulties both in engineering and in the economics of logging operations. Further, there is a ratio between cost of line and cost of logging which must be kept in mind continually. The method to be used in logging or getting the logs to the railway has a direct bearing upon the location, and the topography in turn governs the logging methods.

Rail and Cable Logging—On a logging railway project the main line is that portion that will be maintained throughout the duration of the entire project.

FIG. 2. DRY WALL SUPPORTING ROADBED AT EDGE OF 75-FT. SIDEHILL FILL

A branch line may be of almost any length but is of a more temporary nature, as it will be taken up as soon as the territory close to it has been logged off or cleared. A spur is a short track, usually up to a mile in length, built out from the main line or a branch in order to give more ready access to the timber and permit logging operations to be conducted without blocking the major avenue of transportation. A setting is the point on a spur or elsewhere at which the logging equipment is installed for bringing the timber in to the track. As a rule, the same equipment operates over all lines and spurs, excepting that lighter locomotives may be used on the branches and spurs.

On the Rutledge property described below the logs are in most cases brought to the track by various designs of cableways operated by powerful donkey engines designed especially for logging service. The simplest of these cableways are for ground logging, which consists in attaching the log to the cable by a noose or choker and dragging it in over the ground. They range up to cable spans of 2,000 ft. with carriage; and cable lines up to a mile in length supported on posts. There is a great variety of method and equipment used and steam logging with cables requires a high degree of mechanical ingenuity and judgment, as all installations are more or less temporary and must be moved as soon as the timber within reach has been landed.

Between cable and railway transportation there is co-operation on the main line and main branches. But when it comes to secondary lines there is direct competition, as then it is a question as to which will be the most economical for the last half-mile to two miles. The answer depends upon the nature of the country and the kind and quantity of the timber. On some projects that are prohibitive for railways as many as three donkey engines and cable lines are used, each one hauling in logs and delivering them to the next donkey until the track or river is reached. In addition to much other equipment the Rutledge Co. has a skidder with a reach of 3,000 ft. Logs brought up to the track by the main cables are picked up by the loader and put on the cars.

Rutledge Logging Railway—A typical logging railway system of the modern type is that built in 1921-1922 to serve a forest area of the Edward Rutledge Timber Co. in northern Idaho. This railway includes about 30 miles of main line and 37 miles of branches, and in addition many miles of logging spurs from the branches. The timber area extends northeast from Clarkia and includes the Elk, Childs and Marble Creek basins. These basins are separated by mountain divides 5,000 to 5,500 ft. above sea level and in the form of a Y, so that access to the basins involves the crossing

FIG. 3. GRADING BY STATION GANG

of the ranges. The country is very broken and the drainage is in deep valleys and ravines or gulches. A rail outlet for this district is afforded by the Ste. Maries River branch of the Chicago, Milwaukee & St. Paul Ry. which passes through Clarkia, at the foot of the Elk basin, El. 2,800. The passes to Marble Creek and Childs basin are at elevations of 4,050 and 4,780 ft. respectively. With short air-line distances between controlling points, considerable development was necessary to avoid the use of heavy grades, but as the timber lies in a compact body the entire railway is kept within the company's property.

Flat cars furnished by the Chicago, Milwaukee & St. Paul Ry. are operated over the logging railways and its spurs by 70-ton geared locomotives taking loads of about 550 tons. For these engines there is a machine shop and a 4-stall roundhouse at the Clarkia terminal. The trains are hauled 40 miles from this point by the C., M. & St. P. Ry. to unloading works on the St. Joseph River below Ste. Marie, the logs being floated down the river and Coeur d'Alene lake to the timber company's mill at Coeur d'Alene.

For convenience of logging operations it was desirable to have the logging spurs about one mile apart

FIG. 4. TRACK GANG WITH TRACKLAYING MACHINE

and above as much timber as possible. All the spurs are operated by main line equipment. In this way there would be a maximum cable haul of only half a mile to skidways or loading points on the railway. For such a location the spurs must be directly across the drainage, involving a crooked alignment and fairly heavy grading, together with a considerable number of bridges or trestles. The problem was to locate the main line in such a way as to permit the building of the branches and spurs in their proper positions and at the same time to cross the drainage to best advantage and to go through the heaviest belt of timber. It was found that the best timber was high up on the slopes, where the gulches are relatively shallow, and that if the line was sufficiently high the tops of the ridges could be utilized for the spurs.

Grades and Curves—To gain the necessary height a rapid ascent was necessary at the start and this was made with a grade of 3.5 per cent for about four miles in logged-off or cleared land. This arrangement gave more favorable grades through the logging area to Davies Pass and thence northeast to the limit of the timber. At several points the line had to be held within narrow limits to enable spurs to be located. Beyond Davies Pass the problem was to get a branch line down into the Bussel Creek and Marble Creek basins with fairly light grades, since the grades would be against loaded traffic.

High ground beyond the pass enabled a supported line to be run along the face of the mountain. The gulches and ridges are very long and would be objectionable in ordinary location, as they necessitate a lengthening of the line and much heavy curvature. But in this case they proved an advantage since the long loops would bring the railway closer to more timber and would reduce the length of the spurs without increasing the cost of operation, owing to the lighter grade. Under these conditions the descent was made on a 1 per cent grade, which gives a good balance for

traffic, since a geared locomotive can handle the same number of loaded cars up the 1 per cent grade as empty cars up the 3½ per cent grade.

Maximum grades on branch lines are 5 per cent and are in the direction of loaded movement. One 5-mile branch over an air-line distance of two miles rises from El. 3,710 to 4,780. In other cases 11- and 14-mile branches were necessary for air-line distances of six and four miles, respectively, but the swings were wide and gave access to a great amount of timber. The complete system serves the entire area without switchbacks, with no main-line and but one branch grade against the loads. In the total 67 miles of main and branch line 85 per cent is level or has grades with the loads and 15 per cent has a 1 per cent grade against the loads.

Loops were employed both to gain distance and to lower bridges and develop country. In one case there is a 20-deg. curve to the right for 230 deg. and then

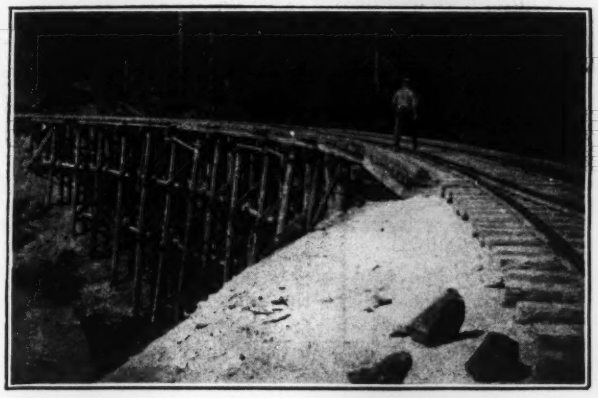


FIG. 5. TRESTLE 60-FT. HIGH ON 20-DEGREE CURVE

to the left for 110 deg. Other cases include 19 deg. curves for 173 and 205 deg. and a 20-deg. curve for 192 deg. Swings of 100 deg. and more are not unusual. Grade compensation of 0.04 per cent per degree is used on all these loops. For the first 12 miles the maximum curvature is 20 deg. and then increases gradually to 30 deg. As the traffic is all one way, the quality of construction was gradually reduced as successive spurs were passed until at the far end the line was an ordinary logging spur without ballast and with very heavy curvature.

Earthwork and Bridges—Grading was fairly heavy, ranging from 15,000 to 40,000 cu.yd. per mile and with considerable bridging on many sections. About 40 per cent was solid rock, the remainder being all classed as "other material." Only a narrow right-of-way was cleared, in order to save timber. Fig. 1 shows an earth cut and Fig. 2 a 75-ft. sidehill fill with a dry wall to support the roadbed.

Bridging is considerable since the lines are continually crossing the drainage. A height limit of 60 ft. was set, even at a sacrifice of curvature, since pile structures could be used up to that height. There is a high fire risk on logging railways and as the burning of bridges must be anticipated only simple structures are allowable. A typical trestle is shown in Fig. 5. It is 60 ft. high and on a 20-deg. curve, with 75-ft. piles 30 and 14 in. diameter at butt and small end respectively. The batter of outer piles is ½ in. per foot.

In the standard trestle design, 5-pile bents are spaced 15 ft. 9 in. c. to c. on tangent. All stringers are lapped, except that in the line under each rail they are butted. Piles that were over 40 ft. long were driven with the butts down. This was considered to give the structure a better balance, to reduce bracing and to permit the use of heavier sticks so that piles could be used for heights which otherwise would require framed structures. Further, as 70-ft. piles are 24 to 30 in. in diameter at the butt, they have a much greater resistance to fire and decay.

Surveys and Construction—A map of the entire property on a scale of 4 in. to the mile and with 50-ft. contours was available and on this a paper location was made after an inspection of the country. A regular railway location party then ran preliminary lines, took topography at 10-ft. intervals, projected the line and then made the final location, which was marked with heavy stakes.

On completion of the surveys, a report was made on the cost of each branch line and the amount of timber upon it, the total property being divided into logging areas tributary to these branches. In this way it was determined what branches were best for working in hard times and in easy times. Average haul for each area was calculated on the basis of "1,000 ft. B.M. miles" instead of the usual ton-miles. This method is much more comprehensive for logging railway service and was devised by the engineer in charge of this work.

Construction was done by the company's organization, with camps two miles apart, the work being let on a yardage basis to stationmen who rented tools and equipment from the company. A station gang on excavation work is shown in Fig. 3. Two light steam shovels were used in grading. Instead of the usual camp foreman in charge of the work, each camp had a foreman-timekeeper who had charge of camp and local minor matters only, the superintendent of construction visiting each camp every day. Track was laid with a Norby track-laying machine (see *Engineering News-Record*, Feb. 19, 1920, p. 373). This machine is shown beyond the spiking gang in Fig. 4. It can lay and pick up track with equal facility, the latter being important in logging operations on account of the numerous temporary branches or spurs. The track has 60-lb. rails on locally-made ties and 10-in. of basalt ballast is used on the main line. When ten miles had been built the line was well in the timber and logging was commenced.

Organization—Surveys, location and construction work were under the direction of J. A. Chamberlin, chief engineer, and O. V. Humason, superintendent of construction, who are at the head of an engineering and construction department which serves various properties of the Weyerhauser Co.'s interests. Surveys and plans are continually being made for various projects, in order to devise economical methods of transportation. If the property is to be opened at once, enough railway trackage is built for about two years' work. Then the logging department extends the line as needed, but according to the original plans for the entire project. At the present time plans are being made for a 50-mile railway in difficult country simply to reach a large timber area of the Clearwater Timber Co. at Orofino, Idaho. This will be followed by the construction of a main line and branch line system of several hundred miles for logging operations that may continue for 40 years.

Construction Plant and Methods On Ohio Stadium

Winter Steel Erection and Summer Concreting Cut Lost Time—Carefully Planned Track System Saved Labor

By W. S. Hindman
Principal Assistant Engineer, Columbus, Ohio

A DEFINITE plan of construction based on the design of the structure, secured unusually rapid erection of the new stadium for the Ohio State University at Columbus, Ohio. A wide flung structure containing 4,300 tons of steel and 25,000 cu.yd. of concrete, much of it very thin sections for seat banks, railings and floors, was substantially completed in 14 months including the winter period from Dec. 1, 1921, to April 1, 1922, when no concrete was placed. However, because of the combination in the design, as described in *Engineering News-Record*, Oct. 19, 1922, p. 640—of a self-supporting steel structure and a concrete encasement, the four winter months were not lost time. During this period all the steel structural work was erected and construction bracing and crane trackways placed for the travelers which later were to handle the concrete. While primarily the combination of steel skeleton and concrete integument was adopted for other reasons than to facilitate erection and permit cold weather construction operations, it also accomplished these essential objects and deserves especial attention for that reason.

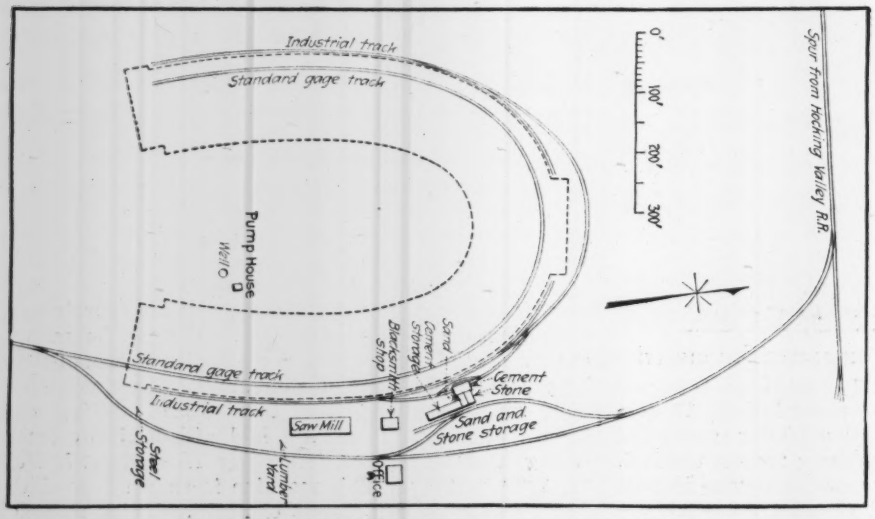


FIG. 1—TRACK SYSTEM AND PLANT ARRANGEMENT FOR CONSTRUCTING OHIO STADIUM

Plant and Track Lay-out—As indicated by Fig. 1 and described in detail in the previous article referred to above, the stadium is in the shape of a horseshoe. A well studied plant and track arrangement for transporting and then handling the materials to place was absolutely essential if the area of construction operations was to be covered without needless rehandling. As shown by Fig. 1 a spur from the Hocking Valley R.R. came into the University grounds just beyond the toe of the horseshoe and about at right angles to the longitudinal axis of the stadium which extends substantially north and south. A standard gage siding from this spur was swung south outside the east leg of the horseshoe and then turned into the east heel of the horseshoe and continued entirely around it to the end of the west heel. All construction materials were brought in on this track and on it were operated also the locomotive cranes for handling the steel and the concrete for footings.

The mixing plant and other buildings—sawmill, lumber yard, office, etc.—were constructed about at the middle and outside of the east leg of the horseshoe and between it and the siding track which swung south from the main spur track. From the mixing plant as a locus, narrow-gage service tracks were carried in two directions so as to parallel the entire outside arc of the horseshoe. These tracks were used almost entirely for transporting concrete from the mixing plant to where it was wanted in the structure. Almost every part of the stadium area, it will be observed, was reached by both the standard gage and industrial tracks.

A mixing plant which was exceptionally well equipped for mechanical operation was installed by the contractor. It consisted of elevated sand, stone and cement bins located over a 1 cu.yd. mixer which in turn was high enough to chute directly into buckets on industrial railway cars. The sand and stone bins were open-top bins and were kept filled by bucket conveyors, into the boots of which the material was discharged from hopper-bottom railway cars. The cement bin was enclosed and weatherproof. It was filled by screw and bucket conveyors from the cement house. Cement was received in bulk and stored in a cement house having three compartments holding a carload each. The mixer was charged by chuting from the bins in the ordinary manner except that the cement was proportioned by weight and was chuted from the bin into a weighing box before being delivered to the batch hopper of the mixer. Fig. 2 is a view showing the weighing box set on the platform of a scale having a dial permitting quick and direct reading. Water was measured by means of a tank and gage calibrated to show the number of gallons used.

Foundation Construction—The foundations consisted of column and wall footings on gravel. About half of the footings were below the low-water level of the river and had to be sheeted and pumped but otherwise involved only simple operations. With a locomotive crane on the standard gage track every footing practically could be dug by clam shell and the same crane could handle the concrete buckets to all footing forms from cars on the industrial tracks.

Perhaps the most complicated task was to locate the footings and more particularly the footing anchor bolts for the columns. Along the axis of the stadium there was an old channel of the Olentangy River and a base line here was impracticable. Two base lines parallel to the axis, one on each side and 250 ft. away, were laid out and the footings were located by co-ordinates from

them. A calibrated steel tape under a constant tension of 25 lb. was used and all measurements were corrected for temperature.

Constructing the Superstructure—Prior to suspending concreting operations on Dec. 1, 1921, about all the column footings had been concreted. From Dec. 1, 1921, to April 1, 1922, the steel was erected ready for the concreting of walls, seat banks and column encasements. Also most of the form panels had been made up and stored.

The principal concreting items were the outside column encasements, the field and other walls, the seat banks and floors, ramps and stairs. Mostly the sections were thin and a large footage of forms was required for a small volume of concrete. For example, in the upper seat bank 100 sq.ft. of forms were required for 1 cu.yd. of concrete. Incidentally it may be noted that there are 21 miles of seat in the structure.

All concrete was delivered from the mixer in buckets on industrial cars. The trains were run to the points on the railway whence a direct lift into the forms could be made. To lift the concrete four travelers carrying stiff-leg derricks were mounted on a track on top of the upper deck steelwork, as shown by Fig. 3. There were two travelers on each leg of the horseshoe and concreting was carried on at four places at the same time.

For the outside walls and columns the concrete was lifted by the travelers and poured directly from the buckets into the forms, in five lifts averaging about 20 ft. each. The seat banks were concreted in 60-ft. sections between expansion joints and in three sections radially for each deck. The concrete was deposited by chutes carried on travelers and having trap doors 5 ft. apart. All forms for the concrete were simple panels carried directly on the steel framing. The aggregate for the superstructure was crushed limestone and limestone screenings which give the concrete a very uniform color. Local gravel and sand were used for the foundation concrete.

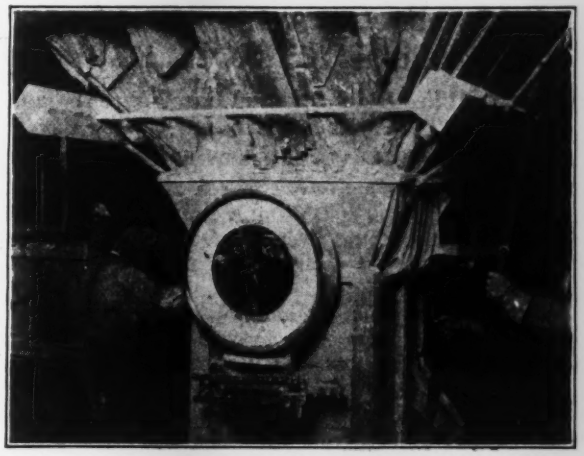


FIG. 2—WEIGHING BOX AND SCALE FOR PROPORTIONING CEMENT

The E. H. Latham Co., Columbus, Ohio, was the contractor for the stadium. Prof. Clyde T. Morris was engineer and W. S. Hindman principal assistant engineer.

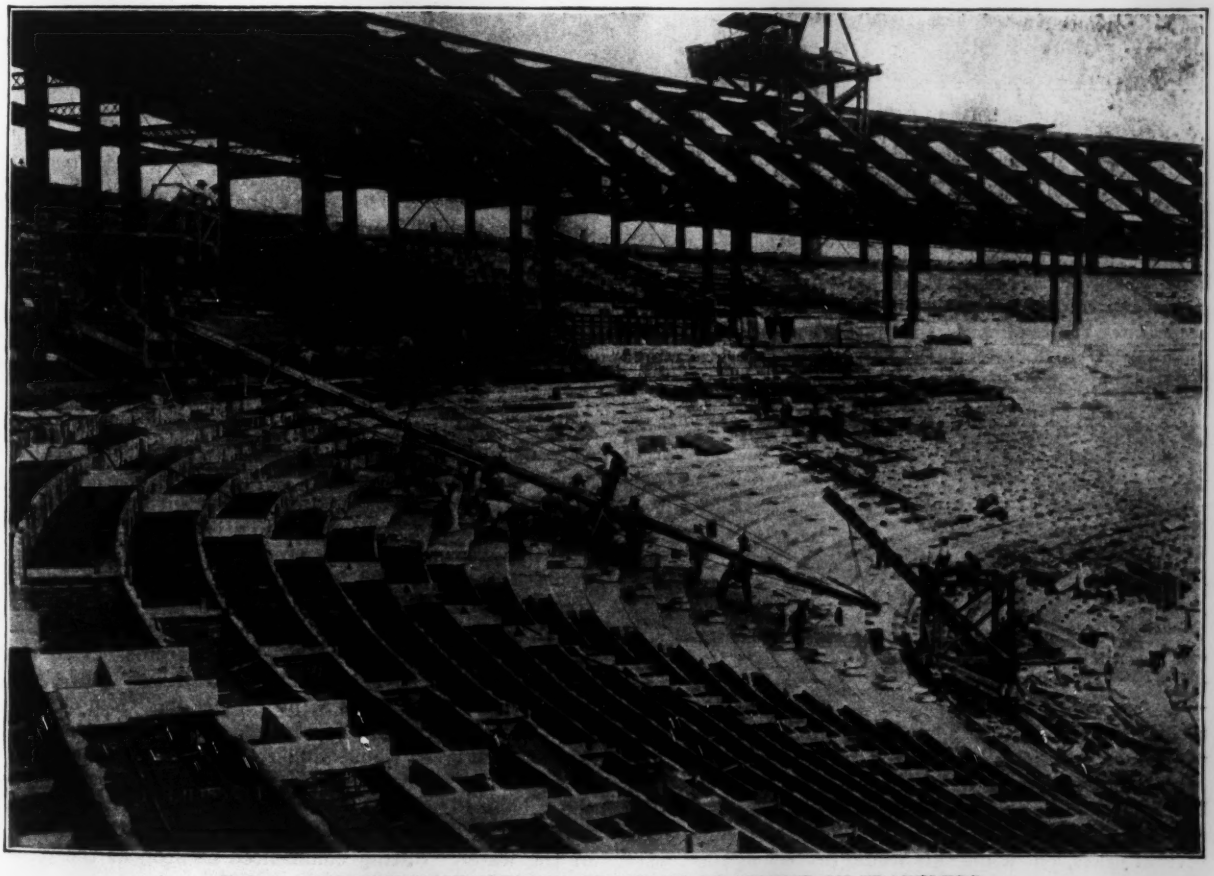


FIG. 3—CONCRETING SEAT BANKS BY MEANS OF CHUTES ON TRAVELERS

Bridge Protected from Shifting Channel: B. & O. R.R.

Permeable Dikes Build Up Sand Bar Where Indiana River Threatened to Cut New Course Through Bridge Approach

PROTECTION of a railway bridge and embankment on the Baltimore & Ohio R.R. against threatened erosion due to a shifting river channel has been effected by the construction of retards or permeable dikes built up of anchored trees and so arranged as not only to check the eroding current and cause silting but also to divert the current in order to cut a direct channel to the bridge. This work was at Washington, Ind., where the railway crosses the west fork of the White River just below a sharp bend in the channel. There are two truss spans of 211 ft. with pile and riprap bank revetment adjacent to the abutments. The situation is shown by Fig. 1 and the plan and sections in Figs. 3 and 4.

FIG. 1—CURRENT RETARD TO CORRECT CHANNEL OF WHITE RIVER, IND.

Anchored trees check current and cause silting so as to divert channel to bridge. Shifting channel eroded river bank at left and threatened to cut railway embankment behind bridge abutment. Note rock revetment on fill.

The original course of the river was a long hairpin bend to the north, between *X* and *Y*, Fig. 3, but this was changed a few years ago by the cutoff in the narrow neck above the bridge, as shown. This change diverted the current so that it attacked the east bank just above the bridge. The erosion encroached on the railway right-of-way and in the spring of 1922 there was danger of destruction of the east bridge abutment and approach embankment, as in nine years the east bank had been cut back nearly 400 ft. Rock riprap had been placed on the slope of the railway fill at intervals for several years, but while this would protect against wash it did not prevent undermining. In March, 1922, about sixty carloads of derrick-size stone were placed, but in August this had all disappeared.

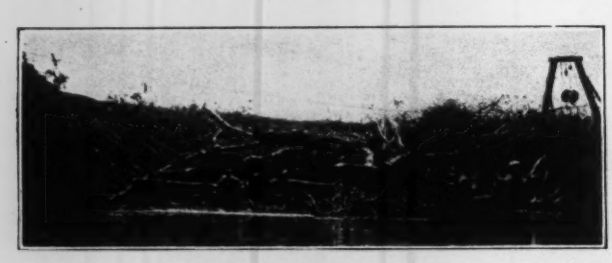


FIG. 2—CABLEWAY PLACES TREES FOR DIKES

Solid dikes to check and divert the current were considered impracticable because a whirlpool which had scoured out the channel just above the bridge, as shown in sections *A*, *B* and *C*, Fig. 4, would probably undermine any such structures. A system of permeable dikes was adopted, therefore, the dikes being composed of whole trees lying horizontal and held in position by cables anchored to concrete piles sunk below the bed of the river and to deadmen on the bank. These dikes or current retards do not stop the flow but check the velocity and thus cause the deposit of sand and silt to build up a bar or shoal which protects the bank and diverts the current to a channel of less resistance.

These current retards are similar to those employed at several points on the Missouri River as described in *Engineering News-Record* of Dec. 15, 1921, p. 966. Concrete 40-ft. jet piles of the Bignell type were used for the anchors, being sunk with their heads about 25 ft. below the bed of White River in order to provide against future scour. These piles were placed by a derrick barge 18 x 80 ft., equipped with pump, hoisting engine and boiler and having at one end an A-frame 30 ft. high. In each retard the first pile was about 10 ft. from the bank and the others about 25 ft. apart. The depth of water at the time was from 2 to 15 ft. To holes in the head of each pile were attached six cables about 100 ft. long. Trees hauled to the work were lashed together in groups and attached to the anchor cables.

One of the difficulties in this work was in getting equipment to the site, since the river is not navigable. For this reason also the trees were not floated into position on scows for launching, as is done on larger streams. Instead, they were hauled out from shore by a steam hoisting engine on the bank operating a cable led over sheaves on a gallows frame set in the water, as shown in Fig. 2. The retard was built about 10 ft. high on the bank to prevent eddies from cutting behind it, and the average height above low water was 15 ft. The trees would sink readily to the bottom and were held in position by the action of the current and the cables. This process was repeated until the retard was of the desired length and reached to the surface of the water. Silting commenced as soon as the trees were in place.

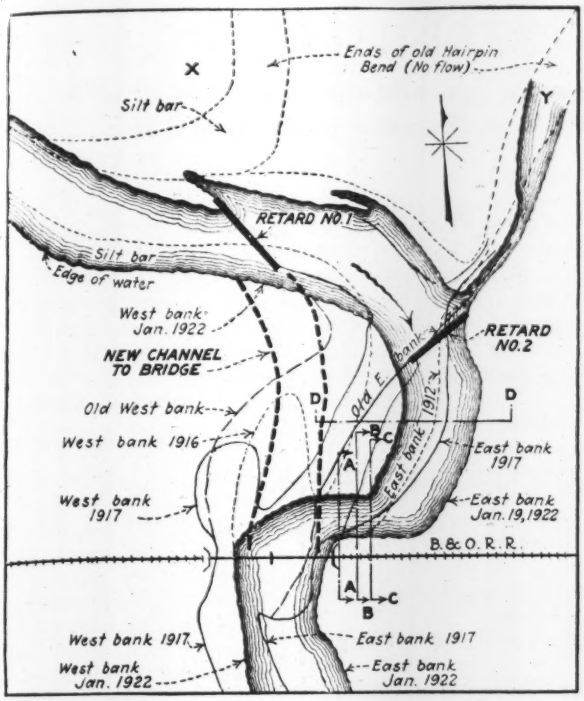


FIG. 3—SHIFTING CHANNEL OF WHITE RIVER NEAR WASHINGTON, IND.

Only two retards were required; the upper one 350 ft. and the lower one 250 ft. in length. Experience has shown that a positive inclination with the current is desirable for the upstream retard in such a situation as this, in order to prevent back eddies above the retard and to provide an easy deflection of the current while the sand bar is being formed. In this case also it was desired to divert the current against the projecting point of the old west bank and thus cut a direct channel to the bridge. The second retard, however, was placed practically at right angles to the current in order to form a bar or shoal that would replace the eroded land and form a protection for the railway embankment.

Cutting of the opposite bank due to diversion of the current began in ten days after completion of the

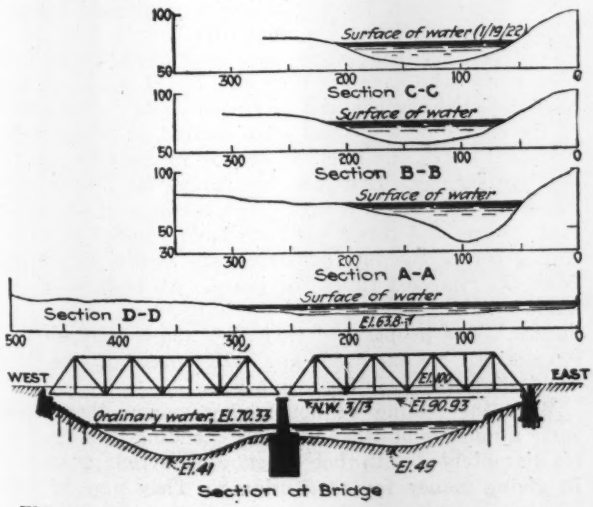


FIG. 4—CROSS SECTIONS AT DANGER POINT OF RIVER

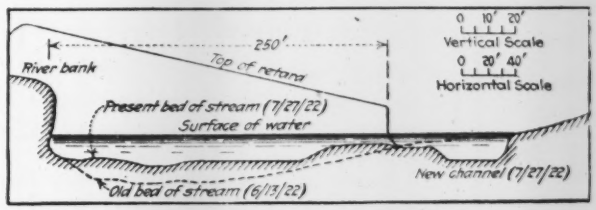


FIG. 5—CHANNEL CHANGES AT CURRENT RETARD NO. 2

retards. Within thirty days this cut had advanced about 50 ft. and a fill of 8 to 10 ft. had been formed at the retard. The relative conditions at retard No. 2 on June 13 and July 27 are shown in Fig. 5. With high water the formation of the new channel will be more rapid. The river has a current velocity of about 2 m.p.h. at low water and 8 to 10 m.p.h. during floods.

The patents on this system of bank protection and river regulation are held by the Woods Brothers Construction Co., Lincoln, Neb. This company was the contractor for the White River work, with a force of about fifty men under Wayne Pringle, chief engineer, with W. E. Bilhorn assistant chief engineer in direct charge. The work was done under the general direction of A. H. Griffith, district engineer of the Baltimore & Ohio R.R. Construction was commenced June 9 and completed Aug. 22, 1922.

Fertilizing Value of Activated Sludge

EXPERIMENTS on the fertilizing value of activated sludge conducted by H. D. Brown, assistant, Experiment Station, Division of Sanitary Engineering, Provincial Board of Health of Ontario, led to the following conclusions, as given in the report of the board indicated for the year 1920, just made available:

(1) The nitrogen in activated sludge was readily available for plant food and was in assimilable form. (2) The sludge was very beneficial when applied immediately prior to planting. (3) Activated sludge gave a rapid early growth which exceeded that of any other commercial fertilizer used. (4) The maturity of the plant was hastened by sludge, so that its value was greater [because it could be marketed earlier].

Altogether eleven different crops were tried, including flax, potatoes, peas, beans, tomatoes, cauliflower, cabbage, carrots, onions, lettuce, tobacco. The plots were about 0.01 acre in area. Various other fertilizers besides activated sludge were tested and all the tests were reported on in considerable detail, with an introductory statement by F. A. Dallyn, chief of the Division of Sanitary Engineering, Provincial Board of Health of Ontario.

Mr. Brown calls attention to the desirability of further investigation with particular reference to finding "an exact measurement of heterogeneity" of crops raised on "soils which appear uniform during preparation and cultivation," but which give "wide variation in results." He specifies these subjects for further investigation:

(1) Variations in chemical composition of surface and substratum soil. (2) Infection of local areas by disease producing organisms. (3) Differences in requirement of food by plants. (4) Physical properties of the soil which vary locally in the size of soil particles, their compactness and resultant variation in aërobic condition and drainage. (5) Lack of uniformity in depth of planting. (6) Drainage at time of planting and during the growing season.

Reaction Against Highway Expenditures

Public Shows Disposition to Retrench on Highway Expenditures—Various Reactionary Influences at Work—Highway Officials Must Organize to Promote Roads

Editorial Review

HIGHWAY construction in the United States is threatened by the danger of a popular reaction against increased expenditures. It is even within probability that in some instances this reaction may proceed so far as to curtail programs now regarded as fixed. A menacing possibility, also, is that it may unseat the policy of centralized engineering direction by state departments and put in the saddle the old practice of district control and local determination of route and type.

This situation is entirely in harmony with the trend of events. Road expenditures have for some time been due for a review by the people. They have been more enormous in the last three years than history has recorded in a similar period for any public work. More than a third of the outstanding bonded indebtedness of all the states is for highways. No such sums of money were spent by the railways even in the years of their greatest extension. The Panama Canal during the ten years of its construction, cost less than half the amount that has been spent for improved roads each year of the last three years. Every such extreme in public expenditure has been followed by a pause to appraise the situation, and there is no reason why highway expenditures should be an exception.

In four years the United States has spent nearly $2,000,000,000 for improved rural highways.

Today one-third of the outstanding bonds of all states are highway bonds.

Does the country need to continue to buy road improvement?

In the opinion of Thomas H. MacDonald, Chief of the Bureau of Public Roads, the production of serviceable highways is not keeping pace with the need.

Statistics compiled by the Bureau show that, even with the last four years of intensive construction, there is a sharp lag in the expenditure for roads of modern type compared with the expenditure for motor vehicles.

This fact indicates that roadbuilding cannot be retarded if we expect in the future as complete highway service as we now have.

Public reaction against heavy expenditures threatens continued roadbuilding unless state highway departments take steps to eliminate and counteract influences now at work.

While the condition that has been outlined exists and cannot safely be ignored, its character should not be misunderstood. There is a spirit of questioning in respect to increased highway expenditures, but there is little material evidence that the public mind is turning away from the conviction that highway improvement is needed. Indeed no pronounced general movement has been made to curtail expenditures. As yet public thought is too unformed to express itself widely in action. It is a feeling rather than a formulated conviction, which exists, that spending money for highly improved highways has gone to about as great lengths as can at present be afforded. Recent action, however, is significant of an approaching agreement of opinion.

More than a thousand taxpayers in central Indiana met a month ago and formed a permanent organization for the purpose of reducing taxes by suspending all road improvements for a period of three years. There was a strong sentiment at the meeting for a modification of the automobile license law so that the money from this source will be distributed among the various counties of the state rather than go to the support of the Indiana Highway Commission. In California a request for extended highway expenditures has been challenged by criticism of the efficiency of the present administration of state highways and the election on Nov. 7 of a governor committed to a program of retrenchment. Highway costs are being publicly criticized in other states. The proposed road bond issue in New Jersey was barely carried at the recent election, although the successful candidate for governor advocated its passage in his pre-election campaign. In general, throughout the country, the people are disclosing a questioning attitude toward highway expenditures. Inquiry and observation by the engineers of the Bureau of Public Roads in practically every section of the United States pronounce the situation to be serious. This opinion is confirmed by a survey by *Engineering News-Record* of public sentiment in a number of the leading road building states. Indeed the conclusion cannot be escaped by anyone who conducts any very wide inquiry.

Public Feels Poor—The controlling reason for a reactionary sentiment toward highway expenditures is that the people feel poor. Prices have declined; wages have gone down; there have been many who have not been able to get work; strikes have depleted savings and increased debts. Just which of the curves of wage and price decline, or what unemployment chart, one elects to employ for specific figures, does not signify. Everyone who labors for hire or produces for sale has a painful consciousness of the main fact. Farm and forest products have dropped in value. The great producing industries are slowly recovering from the "hardest times" of years. All trafficking and manufacturing has reflected the hard times of the producers. The people feel that they must retrench and economize. No one needs any better proof of this than the feeling that is in his own bosom.

With the feeling of not having money, there have come a number of other influences tending to make people discontented with their recent and current generosity in giving money for roadbuilding. They may be enu-

merated and briefly defined as follows: (1) High taxes, (2) economy propaganda, (3) antagonism of the railways, (4) indifferent highway service, (5) original design faults, (6) poor maintenance, (7) automobiles and (8) selfishness. Each of these influences deserves careful consideration. They indicate the objectives which must be aimed at in the counter-attack which state highway departments are called upon to launch.

Increased Taxes—With the people working less and getting less pay for their labor and products, taxes have increased. Besides all the taxes known of old, people are just beginning to feel the hard pressure of state and federal income taxes, gasoline and automobile license taxes, war taxes and taxes on surplus profits. Also there are beginning to come along the taxes to pay for the bonds which have been sold for the roads which have been constructed in the last three years. Again in this instance, no purpose is more perfectly served by taking any of the various tax charts from which to quote specific increase—every man has his own tax bills by which to prove the general fact and for him they are a more potent demonstration than any chart however authoritatively sponsored.

There is a fact of importance, often overlooked, in the last statement. The individual does not segregate his tax payments, generally, nor does he draw average curves of tax increase as does the engineer who thereby finds, perhaps, that the true facts are that road taxes are a small percentage of the aggregate. The individual is conscious that his tax burden is beginning to gall him and he refuses to accept further load and this is the end of his reasoning. It is the error of the highway engineer that instead of individual appeal he presents curves of the trend and allocation of taxes using the figures of a state or the nation. No such error is made by the politician who is striving to bring back the old condition of decentralized direction of highways. He harps diligently on the strings of individual expenditure and saving.

Economy Propaganda—With the individual taxpayer's desire to save and the argument of the local politician that taxes may readily be reduced by different policies and practices, comes the call for nation-wide frugality sounded so persistently by the federal government. In two ways (1) cutting down federal aid appropriations and (2) counseling as a first duty retrenchment in all expenditures, economy propaganda have had a discouraging influence on highway expenditures. They have upheld the hands of every influence acting to discredit all that has been done and planned in highway improvement and the system by which all has been accomplished, and there are many just causes for the criticism of both practices and policies. This has been a natural result following an entirely praiseworthy purpose of stabilizing commerce and industry.

Railway Antagonism—Jealousy by the railways—particularly the electric railways—of highway traffic development by motor-truck freight lines and motor-bus lines for passenger traffic is an influence against extended paved road construction which has to be reckoned with in numerous instances. The circumstances in this case are not clearly differentiated. In general the steam railways, at least those of greatest importance, support the construction of paved roads as traffic feeders to the railway. This attitude is not invariable among the steam railways and is rare on the part of the interurban electric roads.

In instances the attacks of the electric railways have been decidedly venomous; ordinarily they have been no more violent than might reasonably be expected from a private enterprise which anticipated injury to its business by public expenditures which strengthen a competing enterprise. In the question before us, however, the effect is to prejudice in a measure a considerable body of employers and stockholders and their friends against paved road programs.

Just what the measure is of the sentiment to retrench which is being created by the growing rivalry of electric-railway and bus transportation cannot be told precisely. It should not be overestimated but just as certainly it cannot be ignored.

As a matter of fact in many instances steam and electric railways have charged that individual paved roads were potential competitors and have fought their construction. In some states where "railway influence" is powerful, opposition has been offered to road improvement programs which provided to any considerable extent for routes which paralleled the railways. Briefly, the railways cannot altogether escape the charge that they have been one of the influences acting to create a reactionary attitude toward highway development. At the same time that this is said, however, it has to be kept in mind that in some states and by leading companies in most states, railway support of road construction has been unqualified.

Indifferent Highway Service—The natural anticipation by the public that, when money was provided, improvement in transportation conditions would be prompt has often been disappointed by highway officials. Often also they have been indifferent about handling travel during improvement. Both actions have helped to arouse sentiment unfriendly to extended expenditures. It may, indeed, be assumed without much error that no two other faults of direction have been so provocative of discontent.

In the last three years much more attention than previously has been given to the location, marking and maintenance of detours and to preventing the isolation of a farm or a group of residents by closing off construction on unnecessarily long stretches of road. As a matter of fact, however, really careful detour practices are followed only in a few states. The majority of road-construction operations the country over are managed with so little care for the convenience and comfort of the people whose natural line of travel is obstructed by the work that complaint is universal and bitter. An irritable temper toward road improvement is created.

Public discontent because of inconvenience due to construction operations is a zephyr compared with the winds of wrath following protracted delay in commencing improvement. With a large sum appropriated for highway improvements the public expects to see better road conditions immediately. It does not satisfy the situation to explain that a system of paved roads cannot be furnished overnight. And it should not, because the explanation is, bluntly, an evasion. Immediate improvement is always possible preceding permanent improvement. There are sections of states in which great bond issues have been voted, where the people have waited five years, paying taxes all the time on the

bond issue, for the work of improvement to get around to their neighborhood. Ultimately they will have all that they have paid for and waited for, but meanwhile patience has been worn to a frazzle and enthusiasm has died. Indeed reaction has often set in.

Indifference in serving the public with traffic conveniences during the period between voting the appropriation and getting the paved road has done more to estrange the public from extended good roads programs than perhaps any other dereliction of highway officials, although poor design and poor maintenance are close up in the race.

Original Design Faults—Wrecks of broken pavements have created distrust of engineering sufficiency in providing roads worth the money paid. This assertion is made with full appreciation of the truth that the vast majority of road improvements are not failures. It is not forgotten that most of the failures which have occurred are due to service required of the roads which was not anticipated when they were planned. While these explanations are sufficient for the engineer, they do not carry the same conviction to the taxpayer who lives along the road that has gone to pieces. Ordinarily the taxpayer has never been told, and this is the fault of the highway department, that the reason for failure has been a traffic condition whose development could not be foretold when the road was built. Generally he has not been told anything. Having only the evidence of failure, he convicts the road builder without further question.

There have been some bad mistakes in road building. It is reasonable that there should have been. Every highway engineer can point to some example. The original system of a whole state has in instances been inadequately planned. Roads, which, when they were built, the people were told would be permanent are now being rebuilt wholly or in part. These are indisputable facts. The engineer knows them and is not alarmed because he also perceives the reasons. The public knows the facts but it does not also perceive the reasons and it is alarmed by the suspicion that it has been cheated out of its money. In California this suspicion was the foundation of a clear-cut issue in the recent gubernatorial election. On its decision by the people rests the fate of highway department heads long in service and the fate of a bond issue badly needed to maintain and extend the state highway system.

Poor Maintenance Practice—It is, as previously indicated, in not keeping up the roads in the period between the time when the system is taken over for improvement and the time when the actual improvement is accomplished that maintenance practice has been most at fault. Routine maintenance after improvement has often been defective also. Most highway departments have done better with their construction than with their maintenance. In any event good roads in numerous communities have gone to pieces solely because they were denied the upkeep which is the right of any structure doing work. The public witnesses the wreck and concludes that it has been cheated.

Individualism—It appears paradoxical to list the automobilist and the man who already has a paved road going to market as influences against extended highway expenditures. The automobilist, however, is individually fighting increased license fees and other taxes, and even limitations on his truck weights. He is being instructed by his associations in arguments against special taxes on motor car owners and against the use of motor car taxes for road construction. Altogether he has an antipathetical attitude of mind toward highway practice as it exists which is not encouraging to the expansion of highway expenditures.

An even more individualistic influence is the disinclination of the taxpayer who has his improved road to regard with favor an increased expenditure to provide an improved road for the man several counties removed. Most men vote for good roads because they want a good road from where they live to where they go most often. Having got this road they do not cheerfully assume a greater tax burden to get a similar road for some one else. As improved roads increase, this influence against extending expenditures for road improvement also increases.

Organized Educational Work Required—In the aggregate the influences mentioned have become a great force. That this force cannot be expressed in figures does not render it less dangerous. Indeed its dangerous character is thus increased because it presents the highway engineer with the task of combatting a mental attitude in which he is the least proficient of all classes of skilled thinkers. This task, however, is the responsibility of highway engineering for some years to come and if it is accomplished it will have to be undertaken immediately. Briefly the influences named as acting to bring about an inquiry into highway expenditures and practices have to be counteracted by a campaign of information.

The situation is squarely before state highway departments of being obliged to wage battle for their policies and practices. To do this they must organize for attack. They must make educational promotion of road improvement as much their purpose as are construction and maintenance. A special division or bureau is required to do the work and it may not wisely be stinted in financial support or character of management and personnel. The lines along which the promotion organization may well act at the start suggest themselves:

1. Liaison work with country and township highway officials.

2. Detour administration including news bulletins and periodical route maps as well as location, maintenance and marking.

3. Interim maintenance of the whole road system while permanent improvement is progressing. This comprehends the secondary road system as well as the mileage planned for intensive improvement.

4. Cultivating tourist and camper by special service such as route maps, guide books, camp sites and parking spots.

5. Public instruction by lectures, motion pictures, radio news, schools and the newspapers.

6. Individual instruction by personal conference to adjust complaints, explain delays and convert critics.

Each of these activities has been undertaken successfully. Few state highway departments, however, are organized to conduct all of them systematically as a major function of their work. Again it should be stated, organization for educational promotion of highways has to be created and plans of procedure worked out. The character of this organization and its methods of operation will vary in different states because of differences

in fundamental laws and in the legislation establishing the relations of state and county road administration. The main task is alike in all states.

Keep the public "sold" on highways.

This is not the cry of panic; it is a call for preparedness.

Section Lines on Photographs Aid Land Reclamation

Clearing Contracts, Strategic Bridge Locations and Development Work Generally, Planned With Aërial Photographs

AERIAL photography was used effectively in planning the development of a 2,300-acre tract of land which is now under way near the Columbia River in Oregon. The methods used were applicable because the

AERIAL PHOTOGRAPH WITH SECTION AND QUARTER SECTION LINES

The lines are drawn from reconnoissance and meander surveys that give a few controlling points.

tract was level and they offered a particular advantage in this case because any survey work done on the ground had very dense underbrush and a slough network to contend with, so that the cost was high and rate of progress slow. Aërial photographs on which the section lines could be drawn were found to be of great aid in (1) locating roads and bridges, (2) locating drainage ditches that would use existing sloughs as much as possible and (3) in awarding clearing contracts which would make proper allowance for the relative amount of timber and undergrowth to be cleared. The work under way is part of a project for the diking and reclamation of the entire tract.

At the outset the plan was to fly in a straight line across the tract at a height of 2,000 ft. and take photographs every half mile with the camera tilted downward at an angle of 55 deg. With the men and equipment available it was not possible to meet these specifications exactly and an approximation was made to serve.

As the section corners had already been established by government survey these were used as a basis for a meander of the main sloughs. With these data section and quarter-section points were located on the photographs made from the air and the connecting lines were drawn in as shown in the illustration.

With a series of photographs of this sort on which the quarter section boundaries appeared, a very close study could be made and details could be filled in on maps made from the meander surveys. With these data it was feasible to subdivide the area in such a way that instead of cutting up small tracts, sloughs would become natural boundaries replacing fences to a considerable extent.

In addition to the pictures taken at the 2,000-ft. elevation, a few closer views were made to show in detail the thickness of brush and timber growth to be cleared. These photographs, like the general views, more than paid for themselves, according to William G. Brown, Portland, Ore., who had charge of the subdivision and who developed the application of airplane photography to this particular use. A series of aërial photographs of this sort give such a detailed view of the situation, Mr. Brown states, that it would probably save time to make the photographs before running the meander surveys, thus having the advantage of the pictures when planning the first ground survey work.

A Close-Up of Some Wood Borers

What the *limnoria*, one of the most destructive of the marine wood-borers, look like may be inferred from the accompanying magnified photograph of a few of them at work, prepared by the U. S. Forest Service. These borers are about the size of a rice grain and destroy the wood with their crab-like claws. The *limnoria* are found on both the Atlantic and Pacific coasts, subsisting on any untreated wood on which they may find lodgment, piling in harbors affording one of their principal opportunities for existence. Coming in contact with the piling through chance of tide or drift and lodging on the surface or in crevices, they start a system of interlaced burrows on the surface, eating away the softer springwood and leaving the harder

WHAT LIMNORIA LOOK LIKE WHEN AT WORK

Magnified about 7 times.

wood in rib-like ridges. As the outer shell of the wood attacked is in this manner reduced to a spongy consistency, and is broken or washed away, the *limnoria* penetrate deeper and deeper until in time the pile may be eaten almost through and snap off under its own weight. *Limnoria* are especially hard to combat, owing to the fact that they will penetrate the impregnated portion of treated wood through the least crevice or abrasion and occasionally attack treated wood that may have leached out to a low toxicity.

Spokane Intercepting Sewer Design Construction and Assessment

Rational Method of Design Used and Together With Imperviousness Made Basis of Assessment for Benefit

By A. D. Butler
City Engineer, Spokane, Wash.

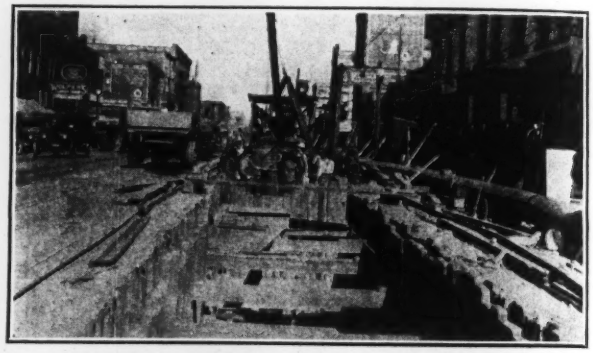
THERE are few things of more importance to the growth and development of a city than proper sewerage, and yet there is no class of public improvement in which it is so hard to interest people. When a sewer is built, it is put far below the surface of the ground and is not fit to be seen even if it could be gotten at. There is nothing to be pointed to with pride as an object of public expenditure. In fact, after a sewer is built it is rarely talked about and would be forgotten altogether if it were not for the unpleasant reminder of the annual payments on the assessments. It is to be hoped that some original engineering mind will devise a method of paying for sewers that will appeal to the public pride. Until this is done municipal engineers must iterate and reiterate the necessity for sewers where they, better than anyone else, know sewers are needed. Meanwhile engineers should address themselves to devising for each case as rational a method of financing sewers as they employ for their design. This article, besides dealing with the design and construction of a large sewer for Spokane, will outline a method of assessment that was devised by the engineering department of the city and that has given rise to only little complaint.

Pressing Need For Interceptor—The construction of the 63-in. intercepting sewer now being built in Spokane was only justified in the mind of the public by a train of circumstances which proved conclusively that the provision of a large sewer could not longer be delayed. In 1893, when the population of Spokane was about 20,000, the present trunk sewer, a 21-in. pipe, was laid. It was sufficient at the time to take care of the district which it served, but during the next ten years Spokane doubled in population and in 1920 it was a city of 104,434. Many times during the year the sewer flowed under pressure, backing into downtown basements and doing more or less damage. It was only after the old sewer had broken twice, and the possibility of enormous damage was apparent, that definite steps were taken to construct an intercepting sewer to relieve the heavily overcharged sewers in the downtown section.

A contract was let for a sewer about a mile long, ranging from 63 to 33 in. in diameter, in the downtown congested section of the city. The contractor was the Miracle Concrete Corporation and the price was $318,000. Because the streets through which the sewer would pass were honeycombed with underground structures, and also because the old sewer connections must be intercepted and connected to the new sewer, it was decided to put the interceptor in the position occupied by the old one. Since the new sewer is 4 to 6 ft deeper than the old one, it is necessary to take care of the sewage in the old sewer while the new one is being laid. To do this, sumps are constructed some distance in advance of where the new sewer is to be laid, and two 10-in. electrically-driven centrifugal pumps installed. A temporary iron pipe is then laid in the gutter and the sewage pumped around the space where the construction work is in progress. This insures a good dry ditch in which to lay the new pipe.

In case of a heavy downpour there was a possibility that the pumps would not be able to handle all the flow in the sewer. It was also foreseen that if the pumps failed to work properly it would be necessary to care for the sewage in the new sewer for some time. To make doubly sure that such an emergency might be taken care of, there is kept in the ditch, at all times, enough sheet-iron flume to connect the end of the old sewer being removed with the new one. This sheet-iron flume is U-shaped, rounded on the bottom, and of sufficient capacity to handle the full flow of the 21-in. sewer, if necessary. It is built in sections of a length that can be readily handled by the workmen on the job. The ends of the flume telescope, and can be put in place quickly when necessity demands.

Precast Reinforced-Concrete Pipe—Due to the fact that the new sewer is being constructed in the downtown section, where it is imperative that traffic should be as free from interference as possible, precast reinforced-concrete pipe is used. This permits backfilling over the pipe as soon as the joints are properly set, and thus makes it possible to keep down to a minimum the amount of ditch necessary to be kept open.



LAYING 63-IN. CONCRETE SEWER AT SPOKANE

Excavated material lifted in buckets by derrick, dumped into motor trucks and hauled back for refilling ditch. At right, pipe in gutter through which sewage from old sewer is pumped around section where work is in progress. Its original thickness was $\frac{5}{8}$ in.

The pipes are cast in 4$\frac{3}{4}$-ft. lengths, each weighing about 5,000 lb. The reinforcing consists of two rings of American steel wire mesh, the cross-sectional area being 0.53 sq.in. for the 63-in. pipe.

One of the reassuring things about the use of a precast concrete pipe is that after the pipe is made and cured, samples may be submitted to a test, which gives a check on the structural design and a very definite notion as to what the pipe will do when submitted to loading conditions in the ditch. During a test of the 63-in. pipe after twenty days curing, using a one-fourth bedding both top and bottom, the first hair crack appeared with a load of 20,000 lb. while a load of 85,000 lb. was required to produce failure of the pipe.

If there was a doubt in the mind of anyone as to whether the new sewer was really needed, it was relieved when the first section of the old sewer was removed. This was a 21-in. steel pipe and was found to be worn completely through on the bottom. Many holes 4 to 6 in. in diameter were found and an innumerable

number of smaller holes showed the pipe had already lasted far beyond what might reasonably have been expected of it.

Assessment and Rational Method Design—Next in importance to the actual design of a trunk sewer is the working out of the scheme of assessment; and since assessments are based on benefits received, the problem entails much study. The design was based on the so-called rational method, in which the length of time of concentration of runoff is taken into account in calculating the size of the sewer. If a theory will serve for the design of a sewer it should also serve as a basis for assessing benefits. With this in mind, the first step was to determine what amount should be assessed against the lateral district or that territory directly abutting on the new sewer which had not only the benefit of sufficient capacity for an indefinite time in the future, but also had the additional advantage of a greater depth than the old sewer. To establish these benefits an estimate was made on a sewer only large enough to accommodate the lateral district and at a depth equal to that of the new sewer. Under the estimate, this cost was found to be about $600 per lot of average size.

There was then a second territory, termed for convenience the Special Benefit Zone, where the sewers originally put in were sufficient until they were overcharged by reason of the outlying territory connecting to them. The plan of the new sewer contemplates the intercepting of this outside sewage before it reaches this district; so that while the Special Benefit Zone does not have the additional depth that is enjoyed by the lateral district, it has the advantage of a sewer sufficient for its tributary area. It was considered that this benefit should be worth nearly one-half that which is enjoyed in the lateral zone, or approximately $300 per lot.

The full amount which would be raised from the lateral benefit and from the special benefit zones amounted to $88,000, which, deducted from the total contract price, left $240,000 to be raised by trunk assessments.

Imperviousness a Factor in Assessments—In determining the capacity necessary for the sewer, studies were made on the imperviousness of the various districts drained. Zone 1, the downtown section, was found by experiment to be 90 per cent impervious, and due to the fact that it lay closer to the sewer and was controlled by shorter and hence more intensive rainfall, it was considered that it was entitled to pay for the proportional increment of size, and hence of cost, that the drainage from this district was responsible for. This was calculated to be 48 per cent of the trunk cost. The remainder of the district, being all about the same per cent impervious, was zoned back concentrically, using the beginning of the sewer as a center, keeping in each zone that territory from which the drainage would reach the intercepting sewer in equal time and establishing a rate of assessment on each zone which would be equal to the particular increment of size, and hence of cost, that this zone actually was responsible for.

Most people are fair minded, and when they understand that their assessment for a given improvement is based on a reasonable method, as I believe this one is, they are willing to pay their assessments, whatever they may be, without complaint.

OLD 21-IN. STEEL SEWER PIPE LAID IN 1893

In spots, the pipe was completely worn through by the grit carried in the sewage.

There were over three thousand pieces of property affected by this assessment and very little complaint has been made.

Many times great care is used by engineers in working out an elaborate design for a sewer or other local improvement, and then the preparation of the assessment roll is turned over to someone outside the engineering staff altogether—some person who has no knowledge whatever of the scientific principles involved. As a result, the distribution of the cost for the improvement is far from equitable. This leads to dissatisfaction and frequently to the courts.

The work of the engineer is not complete when his design for a public improvement is made or estimate prepared. His technical training and scientific knowledge are needed in developing some equitable method of raising the funds to finance the job; for many times, as has been illustrated, the same principles that are used in the design can be carried out in the determination of not only what district is benefited, but also the proportion of the cost each piece of property in the district should bear.

Cross-Connections Put Under Control at Utica

As the result of a letter sent to the Consolidated Water Co., of Utica, N. Y., in the campaign of the New York State Department of Health to eliminate typhoid dangers due to cross-connection between municipal water supplies and private auxiliary fire protection systems, all cross-connections at Utica have been put under control or eliminated, according to a statement made by the department named. After mentioning a special report on cross-connections made by C. A. Holmquist, director of the Division of Sanitation of the New York State Department of Health, the statement reads: "The engineering and biological departments of the water company investigated a total of 76 industrial plants in Utica and vicinity which are supplied by the company. Of these 40 had auxiliary fire supplies, only eleven of which were protected by double check valves. Accordingly the company addressed a letter to each of the plants where potential danger of contamination of the public water supply existed, calling attention to the recommendations of the State Department of Health. The majority of the plants complied cheerfully with the company's request and installed the necessary check valves, or disconnected completely the intercommunicating systems. Since Aug. 1, 1922, all the requirements have been met by all the plants except one which has not been operated for some time and will probably not be reopened.

A Study of High Winds and Thunderstorm Effects

Some Further Notes and Observations on the Storm That Struck New York June 11—How to Measure Velocities

By Jacques W. Redway
Meteorological Laboratory, Mount Vernon, N. Y.

THE thunderstorm which struck the vicinity of New York City on June 11, tornadic both in character and violence, was marked by sudden gusts of wind which wrought not a little destruction. The swamping of many row-boats at City Island and the demolition of a Ferris wheel at Clason Point (*Engineering News-Record*, June 15, p. 1014) were attended by a considerable loss of life. The destructive effects of the wind were noticeable chiefly in the uprooting of trees, the breaking of trees, and shattering of plate-glass windows.

The violence of the storm was manifest chiefly in Mount Vernon, Pelham, and the wooded area in the vicinity of Pelham Bay Park. At City Island, at Clason Point, and along the shore road the destructive effects of the wind were quite as great as at Mount Vernon. Possibly, judging from the number of uprooted and broken trees, they were a little greater; certainly they were not less. The uprooted trees were mainly oaks, growing in soil above rock formation. The broken and

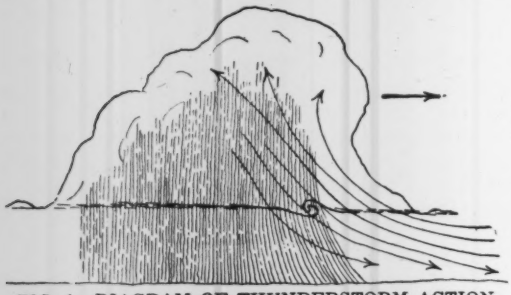


FIG. 1—DIAGRAM OF THUNDERSTORM ACTION

delimbed trees were mainly shade trees, maples prevailing. In Mount Vernon there were many old cherry trees, remnants of a one-time orchard; the gale felled practically all of them. The accompanying barogram (Fig. 2) explains the shattering of plate-glass windows.

Because of the destructive effects of storm winds—that is, winds of 64 miles or more of the Beaufort scale—engineering science is concerned chiefly with winds of this class. When damage to structures occurs from this source, it is necessary as a first step to determine the velocity of the wind and its gusts as closely as possible. Reference, therefore, is made to the records of the nearest Weather Bureau station.

The Robinson anemometer is almost universally employed in the measurement of wind velocities. It is probably the most useful wind meter devised for the purpose, being both practical and foolproof. Its weak point lies in the fact that it does not register sudden gusts. Accompanying a breeze of 20 mi. per hr. are gusts varying from 30 to 45 mi. per hr. They last from a few seconds to about a minute, more or less. The Robinson anemometer does not register nor record them. A Biram anemometer will register them; but to get values, the observer must stand with stop watch in one hand and anemometer in the other.

The anemometer at the New York Station of the Weather Bureau, in Battery Park, is 454 ft. above ground. That at Mount Vernon laboratory is about 35 ft. above ground. Ordinarily the velocities at Mount Vernon average from 40 to 48 per cent of those at Battery Park. During the very high wind storms the registration at the two stations is not very far apart.

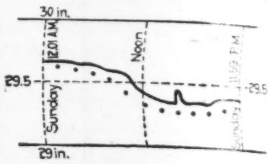


FIG. 2—BAROGRAM OF STORM OF JUNE 11
(Dots are at 2-hr. intervals)

Engineering science takes into consideration wind velocities having a maximum of 65 to 70 mi. per hr.; storm velocities of this value are so common in occurrence that to neglect them would be unpardonable. In New York City this velocity has been exceeded many times; in ten years a velocity of 90 mi. has been exceeded four times. A steady wind of 70 mi. per hr. has a pressure of about 12.2 lb. per square foot. A steady wind of 90 mi. an hr. has a calculated pressure of 19.2 lb. per square foot, which in relation to engineering structures is a matter of much greater importance, inasmuch as for every square of 100 ft. the increase of broadside pressure is about 16 tons. The values are calculated from the formula $P = .004 \frac{B}{30} SV^2$, in which P is the pressure in pounds; S the surface in square feet; V the velocity in miles per hour; and B the height of the barometer in inches. The values differ slightly from Beaufort-scale values. Frankly, I have but little confidence in either—or in the parabolic formula now much used. Perhaps an engineer might not willingly accept the pressure figures of a meteorologist, but the figures noted are not far wrong.

A sudden gust of 90 mi. per hr. is quite a different matter, however. It is comparable to the slapping force of a wave; it likewise involves the problem of inertia. My measurements in the June 11 storm recorded a gale strength of 70 mi. per hr. for a little more than 3 min. and this may be regarded as pretty close to the truth. The maximum velocity of 90 mi. for the same storm was estimated by the Beaufort scale of effects and the destructive effects justify the estimate. When the gust struck, two large maples within 250 ft. of my observation point went down in a crash. About 350 trees in the city were destroyed or badly injured.

Fig. 1 is a cross-section of a thunderstorm, after Humphreys. The experience of observers, covering many years, and of airplane observations in the past six years, attest its correctness in principle. The cross-section is that of a typical cumulo-nimbus cloud. The arrowheads at ground level indicate the advance of the storm and the down-draft of the air. Arrows show also the source of the up-draft. The scud-roll is the locus of gusts. It was this sudden onset that caused the jump in pressure of 0.2 in. almost instantaneously, but I hardly think that this was the tornadic gust that wrought such havoc. Inasmuch as all windows in the house were open there was no accumulated pressure.

Thunderstorms are in the same class of air movements as tornados; and in many instances the difference between them is chiefly one of degree. The jump in pressure, the "thunderstorm nose," as shown in barograms, usually occurs in the case of thunderstorms and tornados, but I have not seen one so sharply defined as this except in the case of tornados, and the storm of June 11 was a tornado.

Effect of 50-Ton Two-Wheel Load On Concrete Test Road

Final Loads on Concrete Pavement in Pittsburg, Calif., Test Road Run Up to 5,000 Lb. Per Inch of Tire

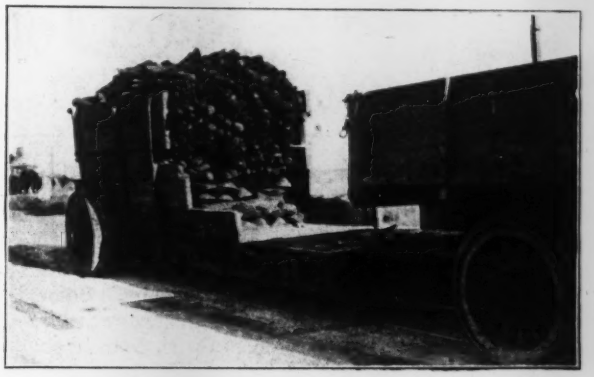
AFTER the completion of traffic tests of the ordinary sort on the Pittsburg test road and before the pavement was removed, some excessive loads were used to determine the ultimate strength of the various types of construction. A 16-ton load was used first and this was increased by stages to 50 tons on two wheels. The latter load moved over the road three times. It caused complete destruction of some sections but was carried over others without being delayed by sinking through the concrete and without breaking up the surface. Whether there was permanent damage to the body of the slab remains to be determined when core borings and other examinations are completed. A preliminary general report of results on the Pittsburg test road appeared in *Engineering News-Record*, June 29, 1922, p. 1066.

On a two-wheel trailer of extremely heavy construction, solid iron bars tied across with chains were used for vertical standards. A facing of 3-in. plank inside these standards completed the superstructure, into which pig iron was piled by hand to secure the desired loading. The wheels were solid metal with steel tires 10 in. wide. For the 50-ton load this gave 5,000 lb. per inch width of tire. This trailer was towed over the test road by tractors and trucks.

With 15 tons on the two wheels the trip over the road was made readily enough, but as these loadings were increased difficulty was experienced in getting over the portions of the pavement where breaks previously made were so large that one or both of the trailer wheels had to cross them. In these spots the great weight on the wheels caused them to sink through the damaged concrete. Steel plates were used at these spots in an endeavor to get the trailer over the road enough times to give an idea of its effect on those sections that had remained intact.

Even with the steel plates to spread the weight, there were frequent delays due to the wheels' breaking through previously damaged pavement and to decrease the delay and difficulty of extricating the trailer from

UNLOADING STALLED TRAILER BY HAND
Where the pavement had already been broken, steel plates were laid in an endeavor, not always successful, to get the trailer across without breaking through.



FIFTY-TON LOAD ON TWO-WHEEL TRAILER

such breaks a device was used to limit the settlement of the wheels. This consisted of a heavy steel plate dragged along the pavement under the rear axle by a chain attached to the front end of the truck. Fastened to the under-side of the rear axle above this plate were two 4 x 6-in. timbers. The timbers normally moved along about 2 in. above the plate but when either wheel cut into the pavement as much as 2 in. the weight rested directly on the axle and further settlement was prevented. By expedients of this sort the 50-ton load was taken around the ellipse three times, as shown in the accompanying table.

RECORD OF TESTS WITH HEAVY TWO-WHEELED TRAILER

Load in Pounds on Two Wheels	Trips Over Test Road	Tons
32,053	105	1,683
61,711	9	278
70,000	3	105
80,000	2	80
100,000	3	150
Totals	122	2,296

NUMBER OF BORINGS REQUIRED TO SECURE SOLID CORES

Section	Thickness, Inches	Reinforcement, Tons per Mile	Inner Side	Center	Outer Side
A	5	20	1	2	1
B	5	20	4	2	5
Alternate J	5	46	1	4	1
C	6	55	1	2	1
D	6	55	1	1	2
E	8	Plain	1	1*	1
F	8	Plain	1	4	1
G	6	69	1	6	1
H	5	24	1	7*	3
I	5	24	4	5*	11
Alternate I	8	Plain	1	1	1
J	6	Plain	1	1	1
K	5	69	1	2	1
L	5	55	1	5	2
M	7	Plain	1	1*	1

* Core taken at ¼ point on account of longitudinal joint in center.

A significant result of the heavy tonnage test was that reinforced sections 6 in. thick, or unreinforced sections 8 in. thick were nowhere broken down by the highly concentrated 50-ton load, nor did they show anywhere on the surface signs of distress as a result. However, in making core borings to get samples of the concrete from various sections there were many instances where the concrete in the center of the slab was disintegrated so that a solid core could not be secured until after repeated attempts. This condition was encountered so much more often in the center of the pavement than at the edge that the results were tabulated for comparison and are shown here in the table.

Sections that did not withstand the 50-ton load, that is, those in which the trailer wheels sank through the pavement into the subgrade, were *A*, *B*, *H*, *I*, and *L*. Sections that carried the 50-ton trailer without any visible evidence of distress were *C*, *D*, *E*, *F*, *G*, *J*, *K* and *M*. (See accompanying table.)

FROM JOB AND OFFICE

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Use of Perfect Squares in Survey Work

BY J. R. JAHN

Williams & Jahn, Consulting Engineers, Berkeley, Calif.

THE "3 – 4 – 5" triangle is well known and the "5 – 12 – 13" one is familiar to many. Some time ago I sought other groups of integers which would have the relation that the sum of the squares of the first two equals the square of the third, the second and third differing by unity. Finding some, I developed the general relation: $n : \frac{n^2 - 1}{2} : \frac{n^2 + 1}{2}$, in which n represented the shorter leg of the triangle. The second and third terms (representing the longer leg and the hypotenuse) are integers when n is an odd number. However, it is possible to reduce even numbers to factors, one of which will be odd and the solution by the formula above will then be possible. Or an even number may be halved and n be taken to represent it in the formula. The second and third terms will be halves of integers. These, doubled, will then be integers.

These ratios have an application in surveying in producing straight lines through obstacles. If the smaller angle of any perfect-square triangle is used as a deflection angle and a distance equal to the hypotenuse be measured and a transit point set, the distance along the true course and the distance out at right angles from the true course will be represented by integers, being the longer and the shorter legs of the triangle. The ratio selected should have an angle which will clear the obstruction. Length may be obtained by taking simple multiples of the selected ratio. Knowing the distance from the true course, it will then be possible to return to the true course by the same triangle, but with the deflection angle double and turned in the opposite direction, or by some other ratio having as a short leg some simple proportion of the length of the departure from the true course.

The following list of perfect squares with their corresponding smaller angles are typical of those ratios having unity as the difference between the second and third term.

Ratio Between Sides	Small Angle	Ratio Between Sides	Small Angle
5: 12: 13	22° 37′	17: 144: 145	6° 44′
7: 24: 25	16° 16′	19: 180: 181	6° 2′
9: 40: 41	12° 41′	21: 220: 221	5° 27′
11: 60: 61	10° 23′	25: 312: 313	4° 35′
13: 84: 85	8° 48′	31: 480: 481	3° 42′
15:112:113	7° 38′	45:1,012:1,013	2° 33′

The number, 12, when substituted in the above formula would have the following ratio, 12 : 71½ : 72½, which does not yield integers, but its factors 6, 2, and 3 give integer ratios, thus: 12 (2x6) : 35 : 37; 12 (3x2x2) : 9 : 15 and 12 (4x3) : 16 : 20.

Portable Conveyors Handle All Materials on Concrete Road Job

PORTABLE conveyors are combined in an interesting manner for handling materials on a concrete paving operation near Elmhurst, Ill., for which the White Construction Co., Chicago, is the contractor. Sand, cement and stone are all handled by three belt conveyors and one self-feeding bucket conveyor, the stone from stockpiles and the sand and cement directly from the cars.

In Fig. 1 are shown the two steel proportioning bins, one, at the left, for crushed stone and the other for sand. At the stone pile a self-feeding bucket conveyor, the top of which appears in the view, takes the stone from the pile and by means of a chute feeds it onto a belt conveyor which leads to the proportioning bin. At the sand bin, a belt conveyor, like that at the stone

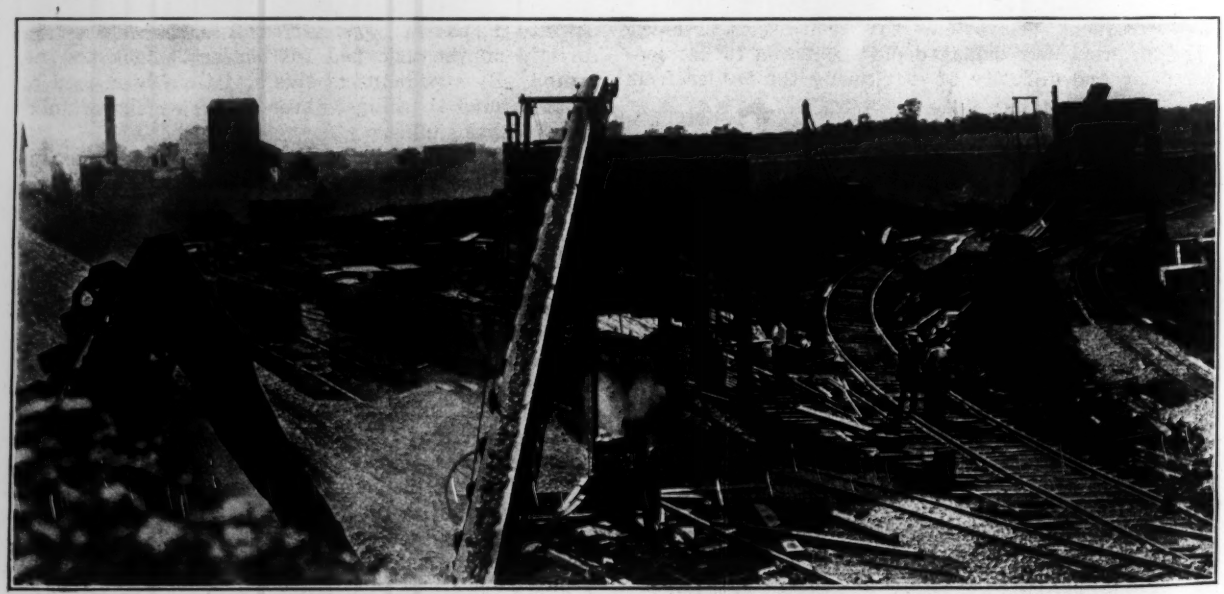


FIG. 1—CLOSE VIEW OF STONE CONVEYOR OUTFIT WITH SAND CONVEYOR IN BACKGROUND

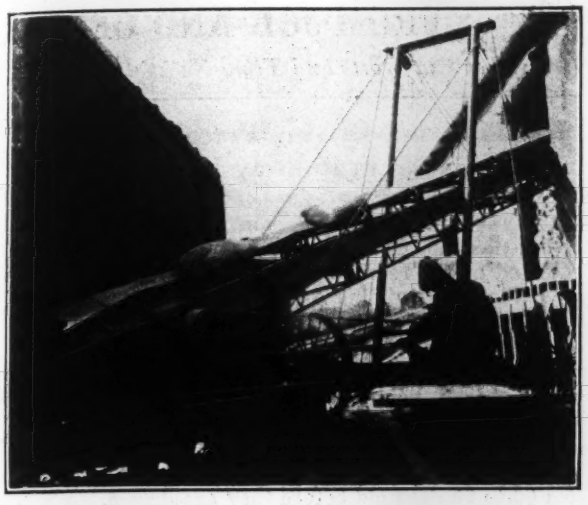


FIG. 2—BELT CONVEYOR UNLOADING FROM CARS INTO CEMENT WAREHOUSE

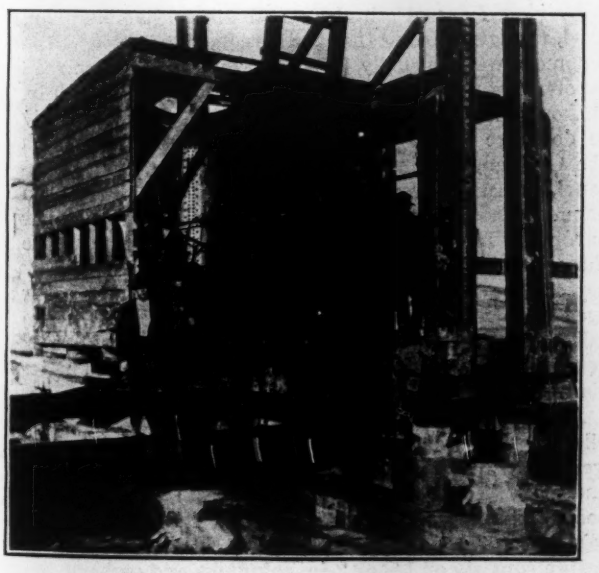
pile, is swung into the cars as they are spotted and delivers directly into the bin. For handling the cement a belt conveyor is operated as is indicated by Fig. 2. In handling cement the belt conveyor has been found a time saver by delivering the sacks high up and thus reducing lifting and stacking.

The views and information for this article were furnished by the Barber-Greene Co., Aurora, Ill.

Piledriver Slides Back and Forth on Two Greased Poles

By W. K. Cresson
4429 Townsend Ave., Detroit, Mich.

IN DRIVING the piles for a section of Detroit's new filtration plant, trouble was had with the soft ground until the contractor hit upon the plan illustrated by the accompanying view. Laying some heavy timbers for a base, the piledriver was mounted on two greased poles 14 in. in diameter and 55 ft. long. The outfit is slid from side to side as needed and is rolled back as the job proceeds. A block and tackle attached to the winch furnishes the pull. Double rigging is used for the side shift and straight away for a back pull.



GREASED POLES GIVE TWO-WAY SHIFT FOR PILEDRIVER

Improved Valley Gutter Design Eliminates Features Objectionable to Motorists

By S. M. Cotten
Civil Engineer, Vallejo, Calif.

IN CONNECTION with the paving of streets in Phoenix, Ariz., the valley gutter across street intersections has been frequently employed. In this construction the crown line is carried through on the center line of one street, and the gutter lines parallel therewith on each side are likewise produced across the intersecting street. The valley gutter proper is of concrete, and is 3 ft. 2 in. wide. The standard pavement section is a parabolic curve, the crown height being 0.1242 ft. per 10-ft. width of pavement between curbs.

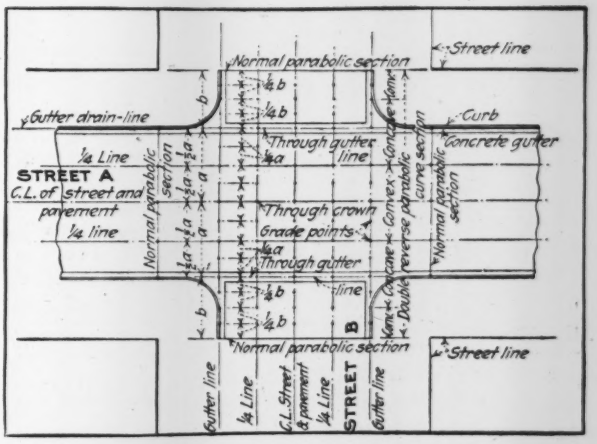


FIG. 1—METHOD OF STAKING OUT VALLEY GUTTER

Until recently these valley gutters were given a dip of 1 in. from edge to center, a distance of 19 in. The normal parabolic section was continued through between the gutters, and a warped transverse surface, varying from a straight line at the gutter to a parabola at the adjacent street or property line, was employed for the intersecting pavement. The consequent change in slopes on a section of the pavement transverse to the gutters did not appear formidable either from appearance or theory, but in passing over such a section in an automobile at a speed in excess of six or eight miles an hour the resulting jolts indicated that the construction was not ideal. Since the elimination of the valley gutter would necessarily mean a considerable increase in the cost of the improvement as a whole, due to the additional drainage structures required, an effort was made to eliminate objectionable features. The new design employed is described below.

Fig. 2 shows a typical half-section of a paved street intersection with valley gutter, the section being transverse to the center line of the continuous-crown paving, as indicated by the typical plan, Fig. 1. The concrete gutter is now made flat, transversely. Referring to Fig. 2 there are three control points on the section, being those on the through crown, h_1, the gutter, h_2, and

the transverse normal section of the intersecting pavement on Street "B," h_9. These points are connected by reverse parabolic curves, as shown. The normal section of intersecting pavements is established at the street lines of Street "A" unless the distances b and e are such as to give a grade from h_3 to h_9 in excess of 3.5 per cent, in which case the distance b is increased as necessary. For convenience, this distance is increased by one-third of the indicated and normal value. This puts the point h_3 on the street line. In our experience, it has never been found necessary to increase b by more than this amount.

Elevations are computed and grade stakes set at points h_1 to h_9, inclusive, on the center line, the quarter lines, and the gutter lines of Street "B," and on these lines produced across Street "A," as shown in Fig. 1. Ordinarily the slope from h_3 to h_9 on the gutter lines is so flat that the gutter is constructed on a straight line between these points, or curved only between h_7 and h_9. It will be observed that the distance d will be practically constant on all of the five lines previously mentioned and on the lines of Street "B," while the distance e changes materially from gutter to center line.

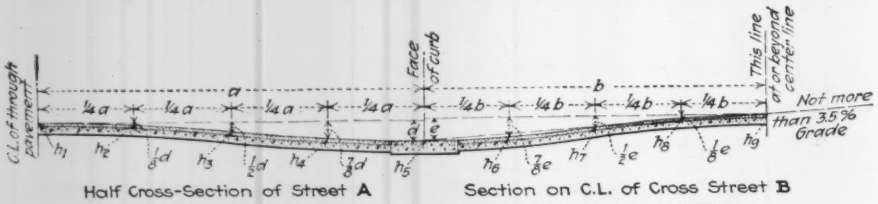


FIG. 2—SECTION ACROSS VALLEY GUTTER ON CENTER LINE OF CROSS STREET

When this method was first devised it was feared that it would involve rather complicated processes as regards office, field, and construction work. In the actual application no difficulties worthy of mention were encountered, and even the contractors have not regarded the innovation as a hardship.

Finding Areas of Irregular Figures With an Analytical Balance

BY WOODSON WANG
Cornell University, Ithaca, N. Y.

THERE are many approximate methods to find the areas of irregular figures such as Simpson's rule, trapezoidal rule, Durand's rule, Tchebyeff's rule, etc. However, none of them eliminates the tedious addition and scaling. Consequently error may easily result. The writer has devised a method of avoiding these drawbacks and at the same time securing a fair degree of accuracy.

This method is easily conducted when an analytical balance is near at hand. The irregular figures are first traced on a sheet of tracing paper and then each is cut out by a pair of scissors. These figures and a piece of tracing paper of unit area are weighed respectively, accurate to 0.001 of a gram. After dividing the weight of each figure by the unit weight, the areas are obtained.

The writer has found that the unit weight of ordinary tracing paper is uniform and hence this method is generally practicable with reasonable accuracy.

[Weighing irregular figures representing areas is not a new device for area determination, but the above is printed with the belief it will reach many who have not used the method.—EDITOR.]

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Handling and Driving Precast Concrete Piles in Railway Work

IN VIEW of the extensive use of precast concrete piles in railway work, methods employed in handling and driving them formed the subject of a committee report presented at the recent meeting of the American Railway Bridge and Building Association. From this report the following material is summarized. Piles 15 to 40 ft. long are used and are usually octagonal, 16 to 18 in. in diameter, with blunt points and sometimes fitted with cast-iron points. A 14½-in. square pile with rounded corners is used on the Chicago, Burlington & Quincy R. R. The curing period is usually 20 to 30 days, or 45 days in cold weather, and piles must be from 60 to 90 days old before they are driven.

Handling Piles—For stacking and loading piles the Illinois Central R. R. uses a locomotive crane with a bridle carrying two pairs of tongs, so that the pile is supported at two points. Piledriver derrick cars unload the piles in a similar way, and each is handled by the piledriver with a single hitch near the top of the pile. Other roads handle them in much the same way as wood piles, but with greater care. One road unloads them by rolling them from cars, but others prohibit the dropping or rolling of concrete piles, although in some cases they are rolled slowly down skids under the control of a rolling hitch. When loaded on cars the rows of piles are separated by cleats 2x6 in. or 3x6 in., these cleats being wired to the side stakes of the car to prevent shifting. The stakes are also secured by transverse tie wires attached at their upper ends. On the Chicago, Burlington & Quincy R. R. it is the practice to load fourteen piles on a car.

Driving Piles—Both drop and steam hammers are used, the latter being the more frequent practice. Drop hammers weigh usually 3,500 or 4,000 lb., but one road reports the use of hammers weighing 5,000 to 6,500 lb. without damaging the piles. As a rule they are likely to do more injury than a steam hammer. But both the Chicago, Burlington & Quincy R. R. and the Missouri, Kansas & Texas Ry. have found a 4,000-lb. drop hammer most effective for driving piles in shale or hardpan. In such soil it may not be possible to drive the concrete pile until a hole is dug or is churned by means of a wood pile with cast-iron shoe, water being used to soften the ground. With the drop hammer the fall should be sufficient to give only the required penetration, since the damage to the pile increases materially as the fall of the hammer is increased.

A special driving head is needed to protect concrete piles as they will not stand the impact of the blows as well as will wood piles. The Illinois Central R. R. and New York Central (Lines West) have used a boiler-plate extension cap or hood 8 ft. long, with an oak follower block and cushion of old rope. Another design consists of 1½- or 2-in. oak disks and eight or ten disks of old rubber belting fitted into the pocket of

FROM JOB AND OFFICE

For Contractor and Engineer

the driving head; old rubber hose or frayed rope may be used also. In any case about four oak disks are used alternating with layers of the rubber disks, hose or rope. If the top of the pile begins to spall it must be cut off.

Holding Piles in Position—Since concrete piles cannot be bent into line when driving, like wood piles, greater care must be taken to keep them in position while driving. Further, the piles must be plumb and properly spaced in the bent, but with square piles no effort is made to keep them from twisting. To insure proper spacing of piles and direction of bents it may be necessary to dig holes 4 to 5 ft. deep or to start the holes with a timber pile. In work on the Chicago, Burlington & Quincy R. R., piles driven on slopes are kept in line by digging a hole several feet deep before starting to drive the piles. For the same purpose on more level ground a checker-board guide is used. This consists of a frame of 8x16-in. timbers with spaces through which the piles can be driven, the frame being braced against the adjacent bents. The tops of the piles also may be braced to keep them plumb. If a concrete pile gets out of line the ground is dug away on one side and the pile is jacked or pulled into position. If the bent of a slab-deck trestle is more than 3 in. out of position, slabs of special length are ordered.

Jetting Concrete Piles—In sand, gravel and soft ground a water jet is used frequently to assist the driving, but in some cases the hole is jetted first and when the pile is started the jet pipe goes down with it. A method used on the Chicago, Burlington & Quincy R. R. and the Missouri, Kansas & Texas Ry. is to have a 4-in. pipe connected to two 2-in. jet pipes, one on each side of the pile and ending with ¾-in. nozzles. A water pressure of 120 to 140 lb. is used.

Piledriving Progress—On the Missouri, Kansas & Texas Ry. the average piledriving per eight-hour day varies from six to ten piles to as low as five or even three, according to conditions. The Chicago, Burlington & Quincy R. R. gives eight to ten piles as a high average and two as a minimum, but in estimating the cost of pile trestles it is usual to allow five piles per eight-hour day. Since the work is slower than with wood piles and the heads cannot be sawed off quickly to clear the track for a train, in the construction of concrete-pile trestles to replace old timber-pile trestles it is necessary for the construction foreman to arrange his work so as not to obstruct traffic. This will depend on the number of trains and the distance the piledriver must move to reach a track.

Paving Brick Relaid After 30 Years' Service

A brick pavement on Walnut St., in Bucyrus, O., torn up because of foundation failure, is, after 30 years' use, being relaid with the original brick turned bottom up. The brick were paving brick of building brick size made by the Bucyrus Brick & Terra Cotta Co., long ago out of business. The base was rolled limestone and the joints were filled with tar; the street had stone curbs. About 90 per cent of the old brick were capable of being reused. The contractors for the original pavement were Frazer & Kiel, of Bucyrus.

Lugs Welded on Suspension Bridge Cable Clamps With Thermit Steel

WHEN the Rondout Creek suspension bridge, recently constructed near Kingston, N. Y., was being built, it was found that the cast-steel cable clamps by means of which the vertical cables were suspended from the suspension cables provided for only one flange to hold the vertical cable from side-slipping off the clamp shoulder, and that an additional flange was needed on the opposite side of the shoulder. As the builders were in a rush, it was decided to weld an additional lug to each of the 114 clamps at a local foundry by means of thermit welding, instead of waiting for new clamps to be cast.

FIG. 1—MOLD FOR BUILDING UP LUG ON CABLE CLAMP

A—Cable clamp casting; B—mold; C—riser; D—pouring gate; E—molding material; F—thermit steel.

Before welding began, a wooden pattern was made of the half clamp to be welded. A wooden lug pattern for the thermit steel flange was doweled to the pattern through two holes drilled into the pattern. A three-sided wooden box, hinged at one corner, was then placed with its open side against the pattern, clamped to the pattern and rammed with molding material. The usual wooden riser and pouring gate patterns were inserted against the lug pattern. No preheating gate pattern was inserted as the preheating was executed in a manner different from the usual. When the ramming was completed the riser and pouring gate patterns were removed, and a plate was placed over the mold. The mold, casting pattern and plate were then inverted and the mold box and pattern removed from the mold, which now rested on the plate.

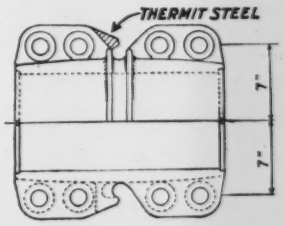


FIG. 2—CABLE CLAMP WITH BUILT UP LUG

The mold was next baked in an oven. In the meanwhile, the part of the casting to be welded was preheated over a blacksmith forge to a temperature suitable for welding. When both the operations of baking the mold and preheating the casting were completed, the baked mold was applied to the casting in the position shown in Fig. 1 and the thermit steel poured into the mold in the usual manner, using 10 lb. for each weld.

Much time was saved by preparing the molds for baking in close succession by applying the same mold box to the same pattern just as soon as the former was removed from one unbaked mold; also by preheating castings successively while baking the molds.

Inner Tube Makes Rod Covering

By Norman H. Gundrum
Junior Highway Engineer, Illinois Division of Highways

I HAVE been having difficulty in keeping the paint on a leveling rod from being marred by scratches and weathering and have found that an old inner tube makes an effective covering. The inner tube should be 30x3½ in., or larger. It is cut to make the tube open at both ends which can then be stripped over the rod.

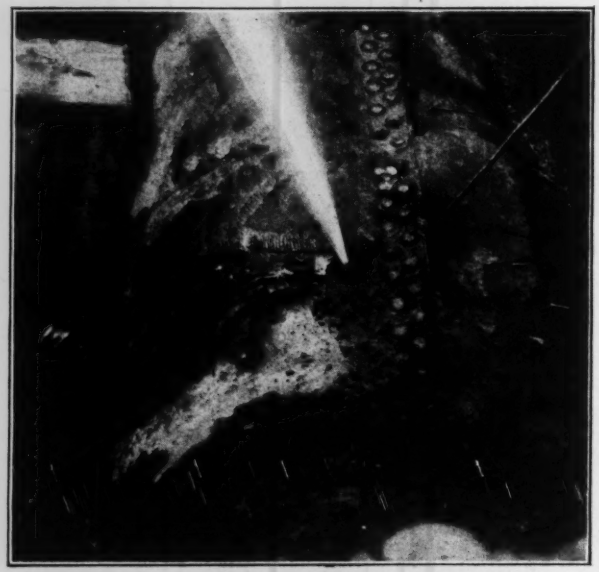
Patches Welded on 30-Yr.-Old Steel Pipe Without Reducing Water Pressure

By J. A. Foulks
Chief Engineer, Department of Streets and Public Improvements, Division of Water, Newark, N. J.

In 1891 the City of Newark laid 26 miles of 36-in. and 48-in. riveted steel pipe and three years later laid a second and third line, making 28 miles in all of 42-in., 48-in., and 60-in. riveted steel pipe. The lines extended for part of their distance through a peat

STEEL PIPE AFTER THIRTY YEARS' SERVICE
Several pits in the pipe are easily discernible. The pine plug has been put in a hole preparatory to its being capped and permanently repaired by electric welding.

swamp, and there sections have deteriorated, mostly through electrolytic action. The electrolysis has probably occurred either from stray current from trolley lines or local action in the soil. The pipe, as a result, has become pitted badly in places, the pits from time to time becoming holes and causing small leaks. Leaks were temporarily repaired by plugging the holes with pine plugs braced with concrete when the holes were on the side or bottom of the pipe and by capping the plug with a lead cover held in place by braces extending to the sides or bottom of the trench; or by pulling



WATER ESCAPING FROM ¾-IN. HOLE
A piece has been welded on several pits near the leak.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

steel bands in place with bolts and running lead between the pipe and the band. While such measures have been more or less successful, they have not been considered permanent and as more permanent methods were necessary unless an entire replacement of pipe was made, electric welding was tried. Results so far obtained have been excellent, the repair is of a permanent nature and secured at comparatively low cost.

Repairs were made for the most part on a 36-in. line laid from Belleville reservoir to the 60-in. feeder on Bloomfield Ave., running through a swampy section. The thickness of the pipe is ⅝ in. and carries a pressure of 90 lb. In several places the pipe sprung leaks which showed up on the surface of the ground. In two sections, for a distance of approximately 10 ft. and 15 ft., respectively, the ground was removed and repairs were made without reducing the water pressure.

REPAIR OF THE PIPE COMPLETED
The patch at the extreme right is that over the ¾-in. leak seen in the figure opposite.

The method of repair was as follows: Where a ¾-in. hole in the pipe was discovered the flow of water was stopped with a pine plug. The plug was then cut off flush with the surface of the pipe and covered with a metal cap held fast by tacking it on the side with an electric arc. The cap used was of metal of approximately a No. 11 gage and was slightly concave. Over this cap metal was welded, extending far enough to get a firm hold on the pipe. All pits were filled and reinforced by welding and a triangular patch of about 9 in. on a side was welded over a number of pits appearing in one spot. The pipe was then recoated. Cost figures kept showed that in the repaired section the cost per lineal foot was about 77c. However, that cost included only labor and materials, and excluded the cost and

FROM JOB AND OFFICE

For Contractor and Engineer

depreciation on equipment, and excavating and backfilling.

The machine used was a gasoline-driven arc welding set mounted on a Ford chassis, consisting of a four-cylinder, four-cycle vertical type engine direct-connected by flexible coupling to a 200-amp. constant-energy type self-excited arc-welding generator, complete with panel for current-regulated steps from 75 to 200 amp.

Why Center Shots in Blasting Misfire

WHERE large-scale blasting operations are carried on, the custom is to fire a number of shots simultaneously by electric detonators usually connected in series and fired either from a power circuit or from a blasting machine. When firing with a hand-operated blasting machine, trouble with missed shots has been frequent. Under such circumstances the shots that fail to fire are often a group in the center of the series. Various explanations have been given as to the cause of these failures and in a paper recently published by the U. S. Bureau of Mines (*Report of Investigations*, 2,384) data which may be helpful in understanding causes of misfiring of center shots are given.

Whatever the source of the firing current generator may be—magneto or battery—the current delivered through a circuit is determined by the total resistance of the circuit. All current leaving the positive terminal must then return to the negative terminal, and if a metallic circuit is well insulated, practically all of the current keeps within the circuit. However, in a shot-firing circuit where wires are frequently in contact with the earth as in wet holes, and where the insulation of the leg wires is inadequate to prevent leakage, the current may take various courses through the earth. Tests show that if a large number of common electric detonators are connected in series and fired under wet earth conditions, a considerable leakage of firing current occurs. The detonators at each end of the series circuit may fire while the middle ones misfire; the detonators near the positive end will fire because enough current has returned to the circuit.

The reason why the middle detonators misfire is not necessarily because the current through them is insufficient but because it is not great enough to fire them before the end detonators have been fired, opening the circuit. In using hand-operated machines it has been found that misfires are more dependent on the current gradient than upon the minimum value of the current.

In order to assist in the elimination of misfiring of center shots, it is recommended that where wet holes are to be shot, the following practice be used: 1. Use waterproof electric detonators with enamelled leg wires (when making connections with enamelled leg wires care must be taken to scrape the ends of the wires well in order that good electrical contact may be secured).

2. Fire the shots from an underground power circuit that has a capacity of at least 30 kw.

3. Use extra precautions when tamping holes in order not to damage the insulation of the leg wires.

4. Arrange the connections between detonators so that they are supported clear of the earth or any other conducting medium.

Pumping Sand with Hydraulic Elevator on Dam Construction Work

A NOVEL use of a hydraulic elevator was made recently at Decatur, Ill., in connection with the construction of the Sangamon River dam. The work consisted in removing sand from a river bar and filling up a deep hole in the river bed. For this work the arrangement was as shown in the accompanying view, the elevator being placed horizontally on a small barge

HYDRAULIC SAND-ELEVATOR ON BARGE

and the pressure-water pipe coming aboard on pontoons with rubber sleeves both at the shore end and the barge end.

The suction pipe was made up of 8-in. pipe and rubber suction hose and its suction end was supported by block and tackle from a small boom with a hand winch. The 12-in. discharge pipe, 300 to 400 ft. long, was supported on barrel pontoons. The discharge end extended down below the water surface, thus eliminating the static head against the elevator, as all joints were fitted with gaskets and made airtight.

Pressure water was supplied by a large reciprocating pump with Corliss steam valve gear. It required 100,000 gal. per hour at 80-lb. pressure to move 50 to 60 cu.yd. of sand per hour. The pressure pipe consisted of 600 ft. of 12-in. pipe on shore and 10-in. floating pipe. The loss was 10 lb., making the effective pressure at the nozzle 70 lb. The elevator worked well at 40 lb., but was most effective at the higher pressure.

This application of the hydraulic elevator was made by George B. Massey, of the Randolph-Perkins Co., Chicago. The design and construction of the dam has been carried out for the city of Decatur by Pearse, Greeley & Hansen, consulting engineers, Chicago, with J. Albert Holmes as resident engineer. Mr. Massey has been called in from time to time as special consultant in connection with earthwork problems.

More on Estimating Floor Slabs

Another letter on the practice of estimating that portion of a slab which rests in the wall has been received from G. Hamilton, of the Du Pont Engineering Co. Writing from Buffalo Mr. Hamilton says:

For estimating concrete quantities, the portion of the slab over the walls should be included in the slab as it has to be finished the same as the central portion of the slab. It therefore obtains a better price than the concrete in the wall. Exception to this is where the concrete walls carry a brick or tile wall up above the floor level. In this case the slab is only considered as the clear span between walls.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The Future of the Drainage Congress

Sir—After attending all the sessions of the National Drainage Congress I consider that this was not such a success as some of the previous meetings. The attendance was not large and the proceedings seemed to emphasize the fact that the contractors and material men had put up most of the expense money and were thus entitled to the greater consideration and prominence in the meeting. However, there were excellent papers and addresses and a large number of exhibits.

There seems to be no definite purpose to these meetings. At the earlier meetings the purpose was to get the federal government to finance and construct the works for draining and reclaiming large areas of swamp land. But it developed that the majority of the members did not favor this plan, especially as the swamp lands are mostly in private ownership. As a result there was a large loss of members. A new policy was founded at the St. Louis meeting of 1919, favoring legislation by which the government would provide data and plans and establish a revolving fund for loans to be repaid from crops raised on the reclaimed lands. This plan also failed to get unanimous approval and more members were lost. Those now in the organization are not a unit as to what the Drainage Congress should try to accomplish.

After the four years of government control of the railroads I should not favor government control of drainage projects. We do not want to raid the national treasury for political projects, as has been done too often in the river and harbor bills. I favor joint action of the national and state governments in carrying on the geologic and topographic surveys and such educational work as the investigation of rainfall, runoff, drainage and flood control conditions. That is as far as we should go in regard to government assistance.

Whether the Drainage Congress will live and exert an influence for good depends largely upon the policies which it fosters, and we are now at the point where the best judgment must be exercised if the organization is to continue. Many of the already too-numerous societies are on the wane and will survive only by combining with each other and consolidating with allied interests. It is barely possible that the National Drainage Congress has done all it can hope to accomplish.

JAMES W. DAPPERT,
Taylorville, Ill., Oct. 2, 1922. Consulting Engineer.

Original Investment Plan Not a New Idea

Sir—Referring to the article by Edward Flad, published in *Engineering News-Record* of Nov. 2, 1922, p. 736, and entitled "Original Investment as a Basis of Value in Rate Making," I beg to call the attention of all who may be interested in this subject to the following:

This article sets forth as a new theory "original investment" as a basis on which to found rates. But this theory is not new, it having been presented by me in a paper before the American Society of Civil Engineers as early as 1914 (see "The Valuation of Public Utility Property," by J. H. Gandolfo, *Transactions Am. Soc. C. E.*, vol. lxxix, 1915, p. 842), and touched upon in discussions before the society even earlier. The only variation is that I use the expression "actual cost to date" where Mr. Flad uses "original investment," both evidently meaning the same thing.

My paper is a full discussion of the entire subject, and all the points mentioned by Mr. Flad are discussed, much more in detail than in his article. Concrete examples are there given to illustrate the various arguments, legal decisions quoted, and references made in the text as the discussion unfolds.

However, even in my paper it was not claimed that this theory was then entirely new, but I do claim that previous to my article it had not been set forth to any extent with arguments, illustrations and legal decisions marshalled in their logical sequence to give the proper support and force to this fundamental idea in rate making.

One thing I notice, that in Mr. Flad's article neither depreciation nor obsolescence is discussed. Both are of the utmost importance in any question of rate making, and are fully treated in relation thereto in my article.

The present abnormally and in many cases totally unjustifiably high costs of all materials entering into construction work, with the consequent high values of any appraisal undertaken on a today's replacement cost, or "present fair value" basis, with or without depreciation, etc., serve only to accentuate the fallacy of founding rates on such a basis, and will, I believe, tend to bring more into prominence for this purpose the "actual cost to date" theory as being most equitable and just to the promoter, the investor, the public, and everyone having any interest in this great question.

J. H. GANDOLFO.
Princeton, N. J., Nov. 3.

Steel Powder as a Concrete Content

Sir—In your issue of Oct. 5, 1922, is described the use of steel powder in concrete or mortar to make the same more impermeable based on experiments by the Queensland Railway Department in 1920.

The use of steel powder for hardening and water-proofing concrete is well known in this country and was fully commercialized long before the experiments of the Queensland Railway.

Generally speaking, the materials consist of ground cast iron or steel, are known as metallic floor hardeners, and are divided into two principal classes, the repellent hardener and the absorbent hardener. Some of these materials have certain chemicals added to the steel or cast-iron powder to accelerate the oxidation when mixed with the gaging water.

In 1918 the writer made some fairly extensive experiments with the use of steel and cast-iron powders in mortar for the purpose of oil-proofing concrete and mortar tanks and succeeded in obtaining a surface finish which would hold gasoline under a considerable head. The method was subsequently used rather extensively for oil-proofing concrete oil barges, etc.

General use has been made of metallic powders in this country for the purpose of making concrete impermeable and considerable information on the subject is available.

New York, Oct. 10. H. FOUGNER,
Civil Engineer.

A New Method of Purifying Water

Sir—In the abstract of my paper, "A New Method of Purifying Water," in your issue of Sept. 28, p. 514, your condensation makes me say, at one point, that the efficiency of the process "would depend upon the amounts of turbidity and vegetable matter in the water." As a matter of fact the efficiency of the process is fully as great, as far as removal of color and organic matter is concerned, whatever the amount of turbidity and vegetable matter, but it would be necessary to scrape the loaded filter just as would be required with any slow sand filter when a water containing a large amount of matters in suspension is being filtered. When a turbid and highly colored water is to be treated by this method, the load of hydroxide should be placed in the lower 3 or 4 ft. of sand in the filter so that surface scraping would not remove it. The question upon this point of turbidity, etc., asked by G. W. Fuller, during the discussion of the paper was as follows:

"The economics of this problem, as I take it, would relate a good deal to the amount of turbidity, mineral turbidity or microscopic organisms like algae in the applied water and then your regeneration period would be controlled by other matters than the amount of organic matter held in the filter sand?" My answer was: "The regeneration

period would not be changed, it would be necessary probably in such a case to scrape the filter just the same as it would if you did not have it loaded with aluminum hydroxide, as you would any sand filter receiving such water."

Boston, Mass. H. W. CLARK,
Chief Chemist,
Massachusetts Department of Public Health.

Favors Diagonal Roadway Joints

Sir—The conventional method of placing expansion joints at right angles to the roadway causes a simultaneous impact due to two wheels landing over the joint at once. Trucks and cars alike often reach a certain speed which causes the vehicle to pound excessively and the travel of the vehicle can almost be said to consist of a series of jumps.

By observation in making sensitive contact over expansion joints of adjacent slabs with trucks passing over the same, I have found a considerable vertical movement between the slabs. It is obvious that this movement does not add to the life of the expansion joints and roadway. It was therefore concluded that were the expansion joints placed diagonally at an angle making it impossible to have two wheels strike at once, the objections previously mentioned would be avoided.

After observing a short stretch of concrete roadway with expansion joints placed diagonally as suggested above, it was found that the jolting and jumping of vehicles was eliminated entirely, and the wear of the joints is reduced to such an extent as to become negligible. This seems to prove that diagonal expansion joints would benefit the traveling public, as well as increase the life of expansion joints and roadways.

This is written with the hope that if published, some state highway engineering department officials or commissioners will find it worth while considering and incorporate diagonal expansion joint requirements in future roadway specifications. It is fully appreciated that from the contractor's standpoint the diagonal joints are somewhat more inconvenient to lay, but the life of the road and the comfort of the traveling public should also receive consideration.

Linden, N. J., JULES VERNIER,
Sept. 29. Industrial Construction Engineer.

Wind Velocities Above the Surface

Sir—Some new data on wind velocities above the surface and their comparison with surface velocities have just been made public by the U. S. Weather Bureau through a monograph by Willis Ray Gregg, meteorologist, in "An Aerological Survey of the United States, Part I—Results of Observations by Means of Kites," forming supplement No. 28 of the *Monthly Weather Review*, issued under date of May 31, 1922. A few comments on this valuable monograph may be worth the attention of those of your readers interested in steel structures of unusual height, such as radio towers.

Observations at six stations in different parts of the United States are recorded. They were made by means of self-registering instruments carried by kites. Flights were made only under conditions favorable for kite flying, that is, in surface winds ranging from 4½ to 45 miles per hour, at which time the wind velocities above the surface ranged from 11 to 75 miles per hour.

The principal tables presented are for average velocities. One table, however (table 21, p. 78), gives maximum velocities, and these, of course, are the ones interesting to the structural engineer. These maximum velocities at the surface varied from 30 miles per hour at Leesburg, Ga., to 65 miles per hour at Ellendale, N. D. At an altitude of 1,000 m. above mean sea level the maximum velocities ranged from 50 miles per hour at Leesburg (altitude of station 85 m.) to 90 miles per hour at Ellendale (altitude 444 m.).

This brief indication of the order of magnitude of the figures would tend to indicate that the upper winds are of considerably higher velocity than surface winds. The conclusion is drawn, in fact (p. 27), that the wind velocity increases up to an altitude of 500 m., and that on the average this increase amounts to about 100 per cent. However, the significant showing of the tables is that the increase noted does not hold for the higher surface velocities. Thus, at the time the velocity of 65 miles an hour was measured at Ellendale, the velocity 506 m. above the surface was only 68 miles per hour.

The observations extended over periods of only one to five years at the several stations. This is too short a period to warrant definite conclusions. The structural engineer who desires to exhaust the possibilities of these data, however, should examine the observations in detail as well as the averages presented. The detail data are accessible to those interested.

The Weather Bureau is to be commended for publishing data while they are new. R. FLEMING.

New York, Oct. 3.

Why Paint Galvanized Sheets?

Sir—A letter from F. H. Thomson in *Engineering News-Record*, Nov. 2, p. 759, under the title "Painting Galvanized Sheets," is quite interesting, but raises the question: Why paint, is it for color harmony or for durability? The writer and his associates have spent considerable time and energy investigating what we term "modern galvanizing." We present the following comments in answer to Mr. Thomson's inquiry.

Properly galvanized steel sheets do not require painting unless for color harmony. By a properly galvanized sheet we are in accord with the opinion of the British Crown Agents for the Colonies who in their Specification No. 1, issued in January, 1920, state: "The galvanizing by the hot process must produce a surface uniform, clean and smooth throughout, and is to weigh not less than 1¾ oz. on each side per square foot of area treated." We recommend such a product which, for ordinary exposures, will not require painting.

The modern galvanized sheet of British or American manufacture does not carry the zinc coating just recommended but, in a recent compilation covering the product of about forty producers in the two countries, has shown from 0.3 to 0.95 oz. with an average of about 0.7 oz. of protective coating per square foot of coated surface. The fact that these coatings are so thin undoubtedly is the principal reason for painting.

In order to obtain satisfactory galvanized sheets one must demand and pay the necessary premium for the quality product, otherwise the galvanizer will furnish a commercial material with insufficient coatings. Sheets with a "two-ounce minimum zinc coating by spot test" (2¼ oz. by weight test or 1¾ oz. on each side per square foot) are produced by a number of the more reputable manufacturers.

In order to obtain a good adherence of paint to a zinc surface the surface must lose its original luster and greasy appearance (not grease, however). The best way is to permit natural atmospheric corrosion for at least nine months. In cases wherein the builder must paint immediately artificial expedients are employed (chief among which are various copper salts), all of which attack the zinc coating causing an immediate surface corrosion. Such methods reduce the protective influence of the zinc enough to make their use inadvisable unless the engineer in charge cannot wait for the atmosphere to perform the same function in a more efficient manner.

Where such painting is done after exposure Mr. Thomson raises the objection that one cannot paint both sides of the sheet at the overlaps, behind purlins, girts, etc. Our experience has been that this has not proven important, such locations being in a protected or semi-protected position, and not subject to the full effects of atmospheric corrosion.

However, we would be interested in learning whether the real trouble does not lie in the purchase and use of galvanized sheets with an insufficient protective coating? We heartily agree with Mr. Thomson in the statement that great benefits are to be had by a free exchange of data on the subject of galvanized products.

F. G. BREYER,
Chief of Research Division,
Palmerton, Pa., Nov. 13. New Jersey Zinc Co.

NEWS OF THE WEEK

New York, November 23, 1922

Relations of Engineers and Contractors Discussed

Fact That Both Parties Are Interested in Building Satisfactorily, Quickly and Inexpensively Is Stressed

A discussion of the subject of the relations between engineer and contractor before the New York Section of the American Society of Civil Engineers on Nov. 15 laid renewed emphasis on the fact that the two parties are interested in the same problem, that of constructing a satisfactory job at the lowest cost and in the shortest time, and that both must contribute toward reaching from the start an appreciation of their mutual interests.

Specific instances were cited to show that in spite of the improvement in contracts and specifications during the last twenty years or so, they are still very frequently drawn in needlessly severe and unfair terms, and that at the same time the keenly competitive nature of the contracting business very often forces contractors to bid even under unfair specifications, which they otherwise would prefer to avoid. Some points commonly overlooked in the interpretation of contracts were mentioned as follows: That the deciding fact in interpretation is the intent that was in the minds of the parties when the contract was made; that a contract where in doubt should be construed against the drawer of the contract; and that the intent of the contract cannot be construed by the terms of any one single clause which is contained in the contract.

FAULTS IN ENGINEERING DIRECTION

Lack of promptness of decision on the part of the engineer, or his unwillingness to make any changes where conditions developing in the execution of the contract indicate the desirability of changes, were cited as common faults in engineering direction. It was emphasized, however, that it is quite impossible to write a specification or even a single clause so clearly that it is not open to different interpretations, and that in view of this fact and the conditions necessarily developing in execution of work it is necessary that the engineer and the contractor agree, that they recognize their mutual rights, and that either party appreciate its own liability to make mistakes. It was charged against engineers that in order to have at their command a sufficiently strong control over the contractor they draw specifications so severe that strict compliance is well-nigh impossible.

Difference of opinion was expressed as to whether the conduct of municipal work must necessarily be subject to different limitations from those affecting private work.

The difficulties affecting federal contract work were also discussed, though not conclusively.

Treaty Formulated to Allocate Colorado River Benefits

The Colorado River Commission met in Santa Fe, N. M., Nov. 13, with Herbert Hoover, Secretary of Commerce. as chairman, and all seven states traversed by the river represented by delegates with power to act. After a four-day session, according to telegraphic reports, the committee agreed upon the main principles of a treaty between the seven states and the federal government for the apportionment of the benefits to be derived from its waters. Secretary Hoover then invited the governors of the seven states to join the commission at Santa Fe at once to give their final views on the treaty. Meantime the commission devoted itself to completing details.

Although the text of the treaty has not been made public it is understood to divide the seven states into two groups with California, Nevada and Arizona in the lower division and Utah, Wyoming, Colorado and New Mexico in the upper division, equal amounts of water being allotted to each division. Preference in right is given to the use of water on established irrigation developments and no existing rights are to be disturbed. Another commission, to meet after the lapse of several years, is recommended. No announcement was made regarding allocation of water to Mexican territory, or whether water passing from the upper to the lower divisions is to be measured. After approval by the commission the treaty is to be submitted for ratification to the legislatures of the several states and to Congress.

Secretary Hoover stated that "the matter of power has been taken entirely out of the hands of this commission by direction of the President to the Federal Power Commission." The flood-protection needs of the Imperial Valley were recognized as extremely urgent reasons for immediate erection of control works.

Fletcher Asks to Be Replaced on Dam Investigating Body

Since the report on the arch dam investigation of Engineering Foundation was published in *Engineering News-Record*, Nov. 16, p. 857, A. B. Fletcher, director of public works of California, has requested that he be relieved of duty on the committee and that W. F. McClure, state engineer of California, be appointed in his place. The report also stated that H. Robert Porter was a member of the committee. This should be H. Hobart Porter.

Coal Association Suggests Lines of Study for New Commission

Washington Correspondence

Seven fundamental points are suggested by the National Coal Association as subjects to which the President's coal commission should give particular attention. They are:

1. The effect on production and on the price of coal, to the consumer, of the monopolistic and absentee control of mine labor.
2. The opposition of organized labor to the introduction of labor-saving machinery.
3. The non-observance by organized labor of contracts made on its behalf.
4. The existing prices of mining materials and supplies and a comparison between them and the prices existing prior to the war.
5. The existing freight rates and a comparison between them and the rates existing prior to the war.
6. The effect of inadequate transportation facilities on the production and the cost of coal.
7. The character and quality of the different coals, the uses to which they are put and the demand therefor.

The most careful attention was given by the National Association to this document. It was formulated from separate drafts presented by the different groups of operators. John W. Davis, former ambassador to Great Britain and former Solicitor-General of the Department of Justice, who has been retained by the association as its advisory counsel, assisted in the preparation of the document.

Alfred M. Ogle, the president of the National Coal Association, met with the Brydon committee when the report was approved. At the close of the meeting he declared that coal operators generally are convinced that the President's commission is going to do a constructive piece of work. He said that the National Coal Association is more than anxious to co-operate with the commission in the most cordial and effective way possible.

Florida to Hold Anti-Mosquito Conference at Daytona

An anti-mosquito conference under the auspices of the State Board of Health of Florida will be held at Daytona, Dec. 6 and 7. This conference is the culmination of a season's intensive work by Chief Sanitary Engineer George W. Simons, Jr., under whose direction the details of the meeting are being arranged. At this conference the general problem of mosquito eradication will be discussed, and ways and means developed for attacking the problem on a large scale. It will be the first of such conferences in Florida. A special appeal has been made to members of the engineering profession to become identified with this program and take the initiative in its launching.

Dr. E. C. Levy Heads American Public Health Association

Dr. E. C. Levy, the recently elected president of the American Public Health Association, has served the city of Richmond, Va., as special investigator of its water supply, city bacteriologist, chief health officer, and is now director of public welfare. In the last named capacity he has charge of various bureaus, including those of health, hospitals, and charities.

After graduation from the Medical College of Virginia in 1890 and service as interne at Mount Sinai Hospital, New York City, for two years, Dr. Levy practiced medicine in Richmond until 1897. From that date until 1900 he was professor of histology, pathology and bacteriology in the Medical College of Virginia. Since undertaking special bacteriological studies of the water supply of the city of Richmond, in 1899, Dr. Levy has been engaged exclusively in public health work. In 1902-3 and again in 1903-4 he took special courses under the late Prof. William T. Sedgwick at the Massachusetts Institute of Technology. In 1904 he made further studies of the water supply of Richmond in connection with the water purification plant then under construction. He became city bacteriologist of Richmond in December, 1906, and from December, 1905, and for some eleven years beginning July, 1906, he was chief health officer of Richmond. During that year he completely reorganized the Public Health Service of Richmond and made special investigations in connection with typoid fever, infantile diarrhea, fly breeding and control.

From August, 1918, to January, 1919, Dr. Levy served in the Medical Corps of the United States Army as camp epidemologist at Camp Pike, Ark., with the rank of major. In January, 1919, he secured an honorable discharge from the army to accept the position of director of public welfare at Richmond.

New Bridges To Span Willamette at Portland, Oregon

By popular vote at the general election held Nov. 7 Multnomah County, Ore., was authorized to issue $3,000,000 for the construction of the new Burnside bridge over the Willamette River at Portland and another issue of $1,600,000 for the construction of what will be known as the Beacon St. bridge. The bonds are to become immediately available and steps are now being taken to prepare and sell them.

West Virginia Passes Road Bonds

Advocates of good roads in West Virginia succeeded at the recent general election, in having passed several bond issues which provide money for hard-surface road construction. In Upshur and Lewis Counties $3,168,000 were authorized at the recent election. Other issues favorably voted upon were: three districts of Upshur County, $784,000; and Freeman's Creek District, Lewis County, $800,000.

The Engineer in Public Life

JOHN H. WILSON

As mayor of the City and County of Honolulu, Hawaii, John H. Wilson, first president of the Honolulu chapter of the American Association of Engineers, is giving to the executive department of the municipal government the benefit of experience gained in more than 25 years of engineering activities in the Territory. There have been only three mayors since the inauguration of the city and county government, and of the three, Mayor Wilson has been the only engineer to serve as the city's chief executive. He has been in office two years.

Mayor Wilson's supporters point out that it is particularly fitting that an engineer should stand at the head of the Honolulu municipal government. The city and county comprise the entire island of Oahu with an area of approximately 600 sq. miles and a population of 123,527. But the old city of Honolulu, so designated before the creation of the city and county government, occupies only a small concentrated part of the island—40 square miles, and has a population approximating 83,000. The greater part of the area under the jurisdiction of the mayor, therefore, is made up of broad country districts wherein road building and maintenance is a strong factor in administration of affairs. The topography of the country is such that proper highway construction requires the most modern and ingenious methods. It was Mr. Wilson, back in the 90's, who constructed the first wagon road over the Nuuanu Pali in the Koolau range of mountains, otherwise impassable to vehicles for the entire length of the island, which they divide in the middle.

Mayor Wilson, prior to his election, undertook private construction work in connection with the Oahu Ry. until 1897 when he joined the staff of the department of public works in the short-lived Republic of Hawaii. He later engaged in private engineering on the islands of Oahu, Hawaii, Kauai and Maui. Between 1908 and 1911 he was superintendent of highways in Maui and of streets in Honolulu. He was city engineer in Honolulu in 1920.

He has taken an active interest in politics as a democratic leader in the Territory and since 1912 has been a member of the Democratic National Committee, attending as delegate the national conventions at Baltimore in 1912, St. Louis in 1916, and San Francisco in 1920. He received his education in the Hawaii public schools and at Leland Stanford Jr. University. He was born in Honolulu, Dec. 15, 1871.

Builders to Meet in January

The twenty-seventh annual convention of the New York State Association of Builders will be held in Elmira, N. Y., Jan. 30-31. Builders of the state and country are invited to attend.

Lincoln New Dean of Electrical Engineering School at Cornell

Paul M. Lincoln, the recently-appointed director of the electrical engineering college at Cornell University, assumed his new duties on Nov. 1. For the past three years he has been associated in an executive capacity with the Lincoln Electric Co., organized by his older brother, which organization he has left to replace Prof. Alexander Gray, who died some months ago. Mr. Lincoln received his collegiate training at Ohio State University, being graduated with the degree of M.E. in E.E. in 1892. His first work after graduation was with the Short Electric Co. at Cleveland, Ohio. Later he went to Pittsburgh, Pa., to work for the Westinghouse Electric & Manufacturing Co. and after about two and a half years with that concern became electrical superintendent to the Niagara Falls Power Co., Niagara Falls, N. Y. He was with that company for seven years, returning in 1902 to the Westinghouse company in an engineering capacity. For the next six or seven years he had charge of the power division of the engineering department, in which division was designed electrical equipment for power plants, generators, switchboards, etc. In 1910 he was appointed a general engineer for the Westinghouse company, remaining there until the date of his resignation in 1919, when he became associated with the Lincoln Electric Co. From 1911-15 he acted as head of the electrical school of the University of Pittsburgh while still carrying on his work with the Westinghouse company.

He is a member of various technical organizations and during 1914-15 was president of the American Institute of Electrical Engineers. He is an inventor of some note, having been awarded the John Scot medal by Philadelphia for his invention of the synchroscope.

Rule of Road Changed in Province of New Brunswick

On Dec. 1 the rule of the road will be changed in the Province of New Brunswick, Can., from left- to right-hand drive. Ten thousand notices, some in French and some in English, have been distributed throughout the province. Motion picture houses are exhibiting special advertising signs and the press of the province is being used in the advertising campaign.

Building Permits and Plans

Under a new ruling of the city engineer's office, the city of Ogden, Utah, will hereafter require plans and specifications to be presented before building permits will be issued. The order is to apply to all buildings costing more than $1,500. Practice up to the present has been to grant permits without presentation of plans. For some time an ordinance has been in force requiring plans and specifications to be presented, but it has not been enforced.

Clearing Snow From Highways Again an Imminent Problem

With the approach of winter those highway departments having snow removal as a special maintenance problem are beginning to think seriously how that problem is to be attacked. Indicative of the difficulties met in some quarters in combatting snow are the notes given below on the opening in the spring season of the Sunset Highway in Washington.

The Sunset Highway crosses the Cascade Mountains in Washington via Snoqualmie Pass at an elevation of 3,010 ft. It is the main route connecting the eastern and western portions of the state. For five or six months every year snow blocks the road and ranges up to 12 or 15 ft. in depth, extending from three to four miles on either side of the pass. Considerable importance is attached by automobile clubs and the motoring public generally to the exact date of opening this road. The highway department is also interested in the time and method of opening the road each year because this has an important bearing on the cost of maintaining the road during the open season. High maintenance costs had to be met in years when automobiles were allowed to go over the road before the snow was properly cleared because the road surface was rutted and cut up under the slush and snow water, which remains on the road for some time in early spring.

In the past two years the snow was cleared from the road in the spring with a steam shovel and before opening it to the public the surface was graded up in the center and adequate side ditches were provided for carrying off the large volumes of water that came from the melting snow piled alongside. This plan has proved so successful and economical that it is now proposed to keep a steam shovel continually on this stretch of highway, using it for maintaining and widening the road in the summer and when the construction season is over each fall, storing the shovel with a supply of fuel near the summit of the pass where it will be conveniently located for starting to clear the road in the spring.

This past season the road was cleared about six weeks earlier than would have been possible without the use of power equipment. The work was done with a standard steam shovel, using a special dipper with a volumetric capacity of 3½ cu.yd., but which actually moved about 5 cu.yd. per load much of the time. This dipper was built with a slight taper enlarging toward the outlet so as to avoid the tendency of the snow to pack and stick in the dipper.

The shovel was used only where the snow exceeded 3 ft. in depth; graders and scrapers being used to clear snow of lesser depth. This year depths ranged up to 11 or 12 ft. and the shovel is estimated to have moved about 125,000 cu.yd. of snow in the eight miles of highway over which it was used.

The total cost of the steam shovel work was about $7,000, or 5.6 cents per cubic yard. The major portion of the cost of this work is borne by King County. Thomas R. Beeman is county engineer.

CLEARING THE HIGHWAY THROUGH SNOQUALMIE PASS, WASHINGTON
The steam shovel, operating over an 8-mile section, handled 125,000 cu.yd. of snow at a total cost of 5.6 cents per cubic yard. The shovel operated in depths ranging from 3 to 12 ft.

Pittsburgh Bridge Raising Order Again Confirmed

According to news from Washington, Secretary of War Weeks has approved the recommendation of the Engineer Corps that all the Allegheny River bridges at Pittsburgh be raised to a uniform height of 45 ft. above mean low water, confirming and sustaining the decisions of former administrations and rejecting recent renewed appeals on the part of Pittsburgh interests for reduction or elimination of the bridge-raising requirements.

British Concrete Institute Changes Its Name

At a meeting on Sept. 28 the Concrete Institute, of London, by vote of its members decided to change its name to "The Institution of Structural Engineers," in which there will be a section devoted to concrete constructional work. This change is partly the result of a development of the activities of the society and partly in answer to a demand of the British law. Some time ago the Concrete Institute began to consider structural problems other than those found in concrete and its papers and discussions more and more covered a wider field. In consequence, the Board of Trade, which has control over such matters, called attention to the Council of the Institute that it was undertaking work considerably beyond the scope of its original articles of association, and that it either must alter the title of the Institute or revert to the more limited scope of activity originally contemplated. There was some opposition on the part of members, first because of the fear that the concrete phase of the society would be submerged, and, second, that the new name would require investigations and studies stepping into the field of a number of the other technical societies, notably the Institution of Civil Engineers and the Institution of Municipal and County Engineers, but this opposition was not strong and the vote was greatly in favor of the change. Of interest to members of similar societies in this country is the fact that the annual dues have been increased from £2 2s. to £3 3s.

To Sell Hog Island

Bids have been called by the U. S. Shipping Board on the Hog Island shipbuilding plant, just below Philadelphia, where fabricated ships were built during the war period under charge of the American International Corp. The date of opening bids is Jan. 30, 1923. The Shipping Board considers that the plant will not again be called upon for shipbuilding purposes and that its value lies in its possible development as a terminal and manufacturing site. All surplus materials which had been stored at the plant have already been sold, and the present offer covers the land and buildings.

Contractors and Engineers to Tour South America

A 69-day tour of South America for a large party of engineers and contractors has been arranged under the direction of "The Earth Mover," Aurora, Ill., and the American Express Co.'s travel department. Sailing from New York on Dec. 2 by the Pacific Steam Navigation Co.'s steamer "Ebro," the party will go through the Panama Canal and visit a number of ports on the west coast. From Valparaiso, Chile, the transcontinental railway will carry the party to Buenos Aires and then another steamer will be taken up the east coast, stopping at different ports and making a longer stay at Rio de Janeiro on account of the Brazilian centennial exhibition in that city. Leaving Jan. 22 on the Lamport & Holt line steamer "Vasari" and stopping at West Indian points it is expected to end the 12,750-mile trip by arrival at New York on Feb. 9, 1923.

Utilities Commissioners Meet in Detroit

Urge Railroad Valuation by States—Suggest Abolition of Express Companies—Other Matters

Faced by augmented problems of railroad and utility regulation, the members of the National Association of Railroad and Utilities Commissioners held one of its best attended annual conventions at Detroit last week. There were about 95 representatives from 37 states at the convention. An appeal for valuation of railroads according to states as well as systems; an urgent recommendation that the Interstate Commerce Commission be given enough money to keep valuations up to date; a suggestion that express companies be done away with and their business handled by railroads; unqualified support of private ownership of railroads and public utilities; and strong recommendation for modification of the Esch-Cummins Bill restoring certain powers of regulation and jurisdiction over distribution of cars of railroads, were outstanding features of the convention.

Mayor Couzens, of Detroit, in his welcoming address urged the commissioners to work toward municipal ownership. So far as the Detroit experience was concerned, he said that they had not yet entirely eliminated graft, interlocking relationships, unreasonable salaries, and other excessive expenses from privately operated public utilities.

President Jackson of the association warned against centralization of too much authority in federal hands, asserting that "if it were not for the activities of this organization, the states would shortly find themselves stripped of local control" in fields wherein the state commissions had superior knowledge of conditions to be governed.

Resolutions Passed

Following the discussion of the report of the committee on valuation the association adopted several resolutions, chief among which was that urging the I. C. C. to find the value of all interstate roads by states, and one urging amendment of the Esch-Cummins law defining the power of the I. C. C. and restoring to the states control over interstate traffic and rates relating thereto. The association also went on record as favoring the giving of assistance to the Interstate Commerce Commission to get a sufficient appropriation for its valuation work that the valuations could be kept up to date when made.

There was a marked tendency to support the requirement of having to get certificates of public convenience and necessity before motor vehicle lines could be operated and the executive committee was requested to draw up a proposed law for submission to the various commissions, to be discussed at the next convention, for suggestion to legislatures in the various states.

The report on express rates went into the question of the lack of necessity for express companies and suggested that it would not be long before it would probably be found desirable to do away with express companies and turn their business over to railroad companies. It was thought by the commissioners that two agencies were unnecessary in the same transaction.

Officers for the ensuing year were elected as follows: President, Dwight N. Lewis, member, Iowa Board of Railroad Commissioners; first vice-president, Alexander Forward, member, Virginia State Corporation Commission; second vice-president, H. G. Taylor, chairman, Nebraska State Railway Commission; secretary, J. B. Walker, secretary, New York Transit Commission, and assistant secretary, J. H. Corbitt, secretary, Tennessee Railroad and Public Utilities Commission. The next convention of the association will be held at Miami, Florida, Dec. 4, 1923.

For Society Secretaries

Three years ago *Engineering News-Record* issued a pamphlet listing the names and addresses of national, district and local engineering societies and clubs, together with the name of the president, the name and address of the secretary, the date of annual meeting and approximate membership of each society.

The list was widely distributed and its usefulness demonstrated to such an extent that we are planning to issue a revised list bringing the information up to date. Blank forms to be filled in and returned have been sent to all organizations of which we have record. If any have been omitted it is requested that their secretaries forward the information noted in the first paragraph of this announcement.—Editor.

British Passenger Train Attains Speed of 100 M.P.H.

A record run on the Great Western Ry. has just been disclosed. An ocean special traveling between Paddington (London) and Plymouth attained an average speed, exclusive of stops, of 66 m.p.h. At times the speed exeeeded 100 m.p.h. while 80 and over was general. An observer on the train says that at the extreme speed the travelling was so smooth that, except for the sound, it was difficult to believe that the train was moving at all.

The run from Paddington to Plymouth is a daily service on the Great Western, the distance of 225 miles being covered in exactly four hours without a stop, this working out at an average speed of 56 m.p.h. Passengers for intermediate towns are dropped by the slip-coach system of which the Great Western has always made a great feature. This run is the longest and fastest non-stop in the world.

Philadelphia Garbage Tankage Sells for $4.27 a Ton

Philadelphia garbage tankage has been sold for the half year October-March to John Meehan & Son, Philadelphia, at $4.27 a ton. The contract is on the "as is" basis with 15 per cent of moisture. John H. Neeson, deputy chief, Bureau of Highways, and head of the Division of Street Cleaning, states that Philadelphia tankage averages about as follows in per cents: Ammonia, 3.17; bone phosphate, 0.07; potash, 0.61.

Narrow Bridges in Pennsylvania To Be Widened

Systematic work in widening the narrow old highway bridges in Pennsylvania is to be undertaken with the beginning of next season, according to plans just announced by the highway department of the state. A recent survey by the department shows that there are 1,834 bridges less than 16 ft. wide, on roads which have been made part of the state highway system. As the law of the state permits the operation of trucks 90 in. wide, most of these narrow bridges will not carry two trucks side by side. Plans for widening the most important of the narrow bridges are now being worked out, so that active work in widening them can be started at the beginning of the 1923 season.

Some of the bridges, 50 to 100 years old, are so weak that it would not be advisable to repair them; these will be renewed. In other cases the cost of widening is too great for the present, and work will have to be held in abeyance until more money is appropriated. In such cases safety signs are being placed reading "Danger: One-Way Traffic Bridge."

It is the present policy of the department to build all new bridges at least 24 ft. wide. The narrow bridges which are not entirely rebuilt but merely widened will be carried to the same width wherever possible. The department will endeavor to retain the contour and general architectural character of the old structures.

Financing American Falls Dam Progressing Favorably

Financing of the American Falls dam, Idaho, creating the largest reservoir in the world, is progressing favorably. In October one irrigation company wanting future storage water paid $150,000 into the U. S. Reclamation Service fund and a second company has sold its bonds and in December will pay in $125,000. The Twin Falls, Idaho, commissioners have set Jan. 16, 1923, as the date upon which an election will be held on the organization of the American Falls Reservoir District which will include 500,000 acres. Barry Dibble is project manager. The American Falls development was described in *Engineering News-Record* Sept. 21, p. 473.

Automobile Unseats Bridge

A 100-ft. iron bridge spanning the Juniata River on the state highway between Tyrone and Bellwood, Pa., was knocked from its seats on Nov. 5 by a speeding automobile which ran into the end of the truss. The span dropped several feet and then wedged against the abutment. The structure was 34 years old. It was damaged so seriously that a temporary bridge will be built at once, to be replaced by a permanent concrete bridge next year.

Moffat Tunnel Decision Favorable

The State Supreme Court of Colorado has decided unanimously in favor of the legality of the proceedings for building the Moffat tunnel, on the Denver & Salt Lake R.R., by means of an assessment district. It had been expected that the decision would be handed down during the first week in January, 1923.

Collapsible Dam Across Maumee River Planned at Fort Wayne

A collapsible dam 300 ft. long and 12 ft. high across the Maumee River is proposed by the city of Fort Wayne, Ind., as part of a project for park work and general improvement along the three rivers within the city. The location is about a mile below the confluence of St. Mary's and St. Joseph Rivers. Floods will be passed by lowering the dam. Funds for the work are now available and the Board of Public Works has issued a request for the submission of plans.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.
AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.
AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.
AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.
ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Kansas County Engineers' Association held its annual meeting in Topeka Nov. 15-17. The following engineers were elected for the ensuing year: President, R. C. Ham, Dodge City; 1st vice-president, W. S. Ruggles, Jr., Winfield; 2nd vice-president, James Irons, Garnett; secretary-treasurer, A. C. Lagerwall, Topeka; and corresponding secretary, J. O. Gunnels, Belleville.

The South Carolina Chapter of the American Association of Engineers held its annual meeting recently at Columbia, S. C. The following officers were elected: L. M. Fisher, Columbia, president; L. S. LeTellier, Charleston, first vice-president; Harwood Beebe, second vice-president; L. A. Emerson, Columbia, secretary, and Charles H. Moorefield, Columbia, and B. R. Cowherd, Greenwood, executive committee. The principal speakers included State Highway Engineer Charles H. Moorefield, Prof. Rowe, the new head of the engineering division of the University of South Carolina, and Prof. L. S. LeTellier, vice-chairman of the State Board of Engineering Examiners of South Carolina.

The Virginia Section of the American Society of Civil Engineers will hold its first quarterly meeting in conjunction with the Virginia sections of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Association of Engineers at the Virginia Military Institute, Lexington, Va., Nov. 24-25. The principal speakers include H. K. Bishop, chief, Division of Construction, U. S. Bureau of Public Roads; C. M. Upham, state highway engineer, North Carolina; T. R. Agg, professor of highway engineering, Iowa State College; Dugald C. Jackson, professor of electrical engineering, M. I. T.; A. J. Brosseau, Chamber of Commerce of the United States, and Dean A. N. Johnson, University of Maryland.

Personal Notes

RANSOME BROWN, of Wichita, Kan., was at the recent general election re-elected to the office of county engineer of Sedgewick County, without opposition. Mr. Brown has held this office for the past twenty years.

EARLE RUSSELL, formerly structural engineer for MacDonald and Kahn, engineers and contractors of San Francisco, has opened an office for private practice in the Santa Fe Building, San Francisco.

JEAN M. ALLEN has established consulting offices in the Monadnock Bldg., Chicago, where he will give special attention to examinations and reports on dredging and earth-moving projects, and other details concerned with engineering for dredging contractors.

GEORGE T. FREITAS, city engineer of Modesto, Calif., has tendered his resignation. It will become effective Jan. 1.

C. E. GRAFTON, county road engineer of Hancock County, W. Va., has resigned and will leave Nov. 26 for San Diego, Calif., to spend the winter.

J. P. TUPLIN, structural engineer, who has been connected with the Foundation Co., 120 Liberty St., New York City, for the past six years, has joined the forces of George B. Post & Sons, 101 Park Avenue, New York City.

W. B. MCMILLAN has become associated with the consulting engineering firm of Thebo, Starr & Anderton, San Francisco, Calif., having severed his connection with the San Joaquin Light & Power Co., with which organization he was associated as resident engineer. In his new position he is office and field engineer.

E. B. WILSON, formerly civil engineer with the Wales Lines Co. of Meriden, Conn., has severed his connection with that organization to become general foreman for the Immick Co. of Meriden, general contractors. At present he is employed in superintending the construction of the New Britain High School.

M. N. BAKER, associate editor of *Engineering News-Record*, delivered a Delemar lecture in hygiene at the Johns Hopkins University School of Hygiene and Public Health on Nov. 20. The subject was "Engineering and Public Health."

GUY HALL has been appointed project engineer with the Missouri State Highway Commission. He is in charge of work in Audrain County and is stationed at Mexico, Mo. Prior to Oct. 1 Mr. Hall was with the Kansas State Highway Commission.

CARL J. LOFSTEDT, until recently a designer with Palmer Bee Co. of Detroit, Mich., has accepted a position on the engineering staff of the Tidewater Portland Cement Co., Union Bridge, Md.

B. E. CLARK, for the past two years state highway commissioner of Oklahoma, has resigned, his resignation to become immediately effective. It is understood he will become associated with the Portland Cement Association in Oklahoma territory.

W. N. WILLIAMS, until recently mechanical engineer with the City of Akron, Ohio, in the Bureau of Water Works Improvement, has become connected with Sargent & Lundy, Inc., mechanical and electrical engineers of Chicago.

ROSCOE L. SMITH, until recently with the Louisiana Fire Prevention Bureau and before that consulting engineer of St. Paul, Minn., has become chief engineer of Houston Dunn, Inc., fire prevention and fire protection engineers of Philadelphia. Prior to his entering consulting practice in St. Paul, Mr. Smith was the engineer of the city water-works department of St. Paul. During the war he was captain in the Quartermaster Corps of the Construction Division of the Army, and assistant to the advisory engineer of water supply.

WILLIAM WADE ELLISON has become superintendent of construction for the S. S. Kresge Co. He was formerly superintendent of construction for the Ford Motor Co.

CARL H. GILMAN has joined the engineering staff of the J. G. White Engineering Corp., general contractors, New York City. He was formerly a resident engineer in the Maine Highway Commission. Mr. Gilman is at present on a job in Pine Grove, Pa.

HAROLD A. THACKREY has severed his connection with the Nebraska State Department of Public Works where he was employed in an engineering capacity, and has accepted a position with the Portland Cement Association as a promotion engineer. He is at present located in Champaign, Ill.

A. E. DREW, until recently a resident engineer employed on highway construction work by Collin County, Texas, has become identified with the Midwest Engineering Co., Silverton, Texas. His position is that of resident engineer.

P. H. BUDD is now attached to the office of the Constructing Quartermaster of the United States Army, New York City, as an assistant superintendent of construction employed in constructing buildings, roads, etc., for different branches of the army. Until recently he was engineer for the Universal Steel Export Co., Inc.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Improved Equipment Will Cut Construction Wastes

Benefits from Closer Contact Between Contractor and Manufacturer Stressed By Marshall

REAL economy and the lowering of construction costs go far beyond the question of field efficiency, according to the views expressed by Brig.-Gen. R. C. Marshall, Jr., general manager, Associated General Contractors of America, in an address delivered Nov. 22 at Buffalo, N. Y., before the New York State Industrial Conference. There is unquestionably need for improvement, and this improvement, he emphasized, should be carried out in co-operation between the men who have developed and are now developing equipment and the men who are using it in the field.

"It is surprising," General Marshall said, "how great the progress in equipment development has been when we recall the lack of contact that has existed between the manufacturer and those who use his machines. In producing new devices for one or another of the manufacturing industries development has been fostered by co-operative studies of plant facilities which profited from creative minds of both the machinery manufacturer and his customer; but in the construction industry there has been little such co-operation. Construction companies have either accepted or rejected the devices placed before them, while the manufacturer's principal guidance from the field has been his record of complaints. As these complaints have not always been of a constructive character they have failed to furnish the necessary information and both groups have suffered through lack of contact."

Contact Between Maker and User

The manufacturers, General Marshall pointed out, have been handicapped by this want of constructive study and criticism from the field where the true value of every new device is determined, and construction companies have been handicapped by the lack of adequate means for reaching the manufacturer and obtaining the incorporation of ideas into machines suitable for the work. The time has come, however, when both parties appreciate the value of eliminating this breach and the initial steps have been taken to establish proper co-operation between them. To this end a joint committee of representative equipment manufacturers and members of the Associated General Contractors of America, which was recently appointed at Detroit, will investigate the development of equipment, construction practices, and other matters that will expedite the adoption of efficient methods as explained in *Engineering News-Record*, Nov. 2, p. 765.

Not one construction project in five, according to General Marshall, is carried out under the most effective methods that could be devised for that particular piece of work. On almost every construction project the problem arises of whether it is more economical to buy additional equipment and install a superior method than to use existing plants and a method less effective. This means, he said, that the real economy in methods arises from operating plants that are not necessarily the most effective for each particular job, or even for any particular job, but which are the most all-around adaptable for all of the jobs that the construction company expects to perform. Therefore, in investigating and improving construction methods, it is necessary, General Marshall believes, to consider not only the most effective means of performing a particular type of work, or a particular type of project, but also the variety of work for which a particular plant and method can be employed.

To Confer on Numbering of Steel as Quality Index

To consider the desirability of designating qualities or kinds of steel by code numbers, a conference will be held on Dec. 6 at the Department of Commerce Building in Washington under the auspices of the American Engineering Standards Committee. The movement originated with the Bureau of Standards. It is said that a system of number designation already has wide currency in the field of automobile steels and that there is a desire in some quarters to apply such a system more widely. Uniform numbering systems for various classes of steels will be considered separately, and a joint system for all steels will also be discussed. The substitution of numbers for existing brand names will be considered.

Slate Industry to Meet

Manufacturers, producers, distributors, dealers, roofing and other contractors using slate are planning to gather in New York at the Commodore Hotel, Jan. 25 and 26, for the slate industry meetings to be held under the auspices of the National Slate Association. Roofing contractors and other users of slate will discuss the program for a co-operative promotion of the use of slate and the betterment of the conditions and relations within the industry, which Secretary Hoover urged the progressive concerns of the industry to undertake at the first meetings last year.

Crushed Stone Association to Meet in Chicago in January

Broad questions such as transportation, financing developments, the importance of geological studies in proposed sites, etc., will be on the program of the convention of the National Crushed Stone Association to be held in Chicago, Jan. 15-17, 1923. Group sessions at which trade details will be discussed will also be held. Nathan C. Rockwood is chairman of the entertainment committee.

To Place American Export Trade on Sounder Basis

A house-cleaning to eliminate the unscrupulous and insincere element generally from the American export field was advocated recently by Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, speaking before the Export Managers Club, New York City. With improving conditions, he declared, these undesirables are beginning to reappear in export centers. It is the duty of every believer in the economic future of this country, he said, to help stop their operations.

American exports are now moving out at the impressive rate of nearly $4,000,000,000 a year—a formidable figure which is vital to the stability of our whole industrial and commercial edifice. It must not be jeopardized by the dealings of irresponsible opportunists. Our sales abroad are no longer confined to a few big self-selling staples like cotton, wheat or copper. Nearly 49 per cent of American exports are now made up of manufactured or partly manufactured articles, great quantities of them being the products of factories which were expanded during the war and are now realizing the value of permanent overseas outlets.

Bureau's Function Explained

The function of the Bureau of Foreign and Domestic Commerce, Director Klein explained, is to promote American commerce abroad. Whether the manufacturer or merchant requesting aid is large or small makes no difference. The biggest corporations and banks in the country make constant use of the bureau. It is also being called upon every day by thousands of small factories and dealers whose individual export interests amount to less than $10,000 a year. In the week ending Sept. 23, the bureau's New York office handled foreign-trade problems for no less than 10,200 inquirers whose transactions were of all sizes and descriptions.

Director Klein predicted a gradual but sound rebuilding of our export trade and said that the Department of Commerce is making every effort to bring the profits from it into every small manufacturing village in the country. In connection with our future welfare in the overseas markets he asserted that price cutting and long terms are not the trumps in America's hand. In his opinion well-directed sales effort, honest desire to do business at a moderate but adequate profit over a long term of years, co-operation with the foreign distributor and well-conceived advertising, are the weapons of America. They can be used just as well by the small manufacturer who knows the wants of his foreign customers and how to satisfy them as by the gigantic corporation.

Paving Brick Makers to Meet

The annual meeting of the National Paving Brick Manufacturers' Association is to be held in Cleveland, at the Cleveland Hotel, Dec. 12-13. The meeting is to take the nature of a business review. Announcement of a program will be soon forthcoming.

Winter Buying of Pipe

Discussion continued from last week's issue.

GEORGE W. BATCHELDER
Water Commissioner, Worcester, Mass.

I have read with much interest the article you sent me concerning seasonal buying of pipe. It appears to me that the arguments advanced are sound and logical and I believe it would be better all around if the purchase of pipe could be more evenly distributed, but unfortunately most water departments use up their appropriations pretty closely at the end of their fiscal years. We do not get any other appropriations until three or four months later. Consequently it is difficult to make large obligations during the winter months.

The City of Worcester was fortunate some years ago, just previous to the war, in having a considerable balance available for the purchase of water pipe at the end of the fiscal year Nov. 30. Pipe was purchased at that time at what we consider a very reasonable figure, the foundry I believe wanting the business, but an opportunity of that sort is exceptional.

DOW R. GWINN
President, Terre Haute (Ind.) Water Works Co.

The spreading of cast-iron pipe purchases over the entire year is a good idea and is worth consideration. Our friends, the manufacturers, suggest that pipe can be made at a lower cost in the winter; if they are willing to give the buyers a fair share of the saving, winter purchases may be stimulated.

Objections to several of the points made by the manufacturers are as follows: (1) Bad policy to have pipe delivered to streets several weeks or months before it is laid; danger of injury to pedestrians, when it becomes an obstruction due to being rolled by boys. (2) Accumulation of dirt in pipe. (3) Pipe broken in dropping from truck when ground is frozen. (4) Added cost for storage and rehandling when it must be held until needed. (5) Winter weather is variable in Terre Haute; some years there is practically no frost, but one year there was 4 ft. penetration.

There are some advantages in laying pipe in cold weather: (1) Even the lazy man must work to keep warm. (2) Ordinarily labor is more plentiful in winter. (3) It is a good thing to be able to furnish employment to the unfortunate and improvident when outdoor work is scarce.

Where it is necessary to lay pipe for the good of the service, such as reinforcement of the system, it would be well to plan to take advantage of a favorable price in the winter if it can be secured. However, where orders for extensions ordinarily follow building operations and these do not start until spring, one cannot always anticipate quantity needed or the sizes that will be required. Limited winter purchases might be advantageous where the water utility is a large one and has a storage yard with switch track and modern facilities for unloading.

Perhaps it might not be out of order to mention one reason why water utility operators have been buying only enough pipe to take care of current requirements—the belief, whether well founded or not, that the price is too high, out of proportion with other commodities (including water rates), and that it must surely be reduced; that if liberal purchases are made, the manufacturers will be encouraged to maintain prices.

Business Notes

OSGOOD CO., Marion, Ohio, manufacturer of steam shovels, has established a district sales office at 50 Church St., New York City, with M. E. Pullen in charge. All business of the company, previously handled by M. E. Davis, former New York representative, will now be handled through the district office.

ED. C. WILSON, formerly connected with the U. S. Light & Heat Corp. and the Vapor Car Heating Co., with offices at Chicago, has been appointed Western sales manager for the Ohio Locomotive Crane Co. of Bucyrus, Ohio, with offices in the Railway Exchange Building, Chicago.

HARRY BENJAMIN EQUIPMENT CO., St. Louis, Mo., has just purchased 100 miles of 75-lb. relaying rails from the St. Louis Southwestern R.R., which will replace them on the main line with heavier rail. The Benjamin company plans to dispose of the used rail to the smaller steam and electric lines and will export part of the supply. The transaction, it is pointed out, is on a considerably larger scale than is customary for this class of material.

FREDERICK FRANZ, who, for the past four years, was chief engineer of the Terminal Engineering Co., manufacturers of the TEC truck which is designed for combined indoor and outdoor service in connection with railroads, shipping and industrial plants, has established an engineering office at 27 Warren St., New York City, for the purpose of solving special problems of engineering relating to labor saving machinery for industrial plants.

LINK-BELT CO., Chicago, announces the promotion of W. W. Sayers to the position of chief engineer of the company's Philadelphia works and Eastern operations. For many years Mr. Sayers was a representative of the company in its Chicago territory in lines related to power-house machinery, coal storage, Peck carriers, crushers, etc., and later in charge of the locomotive crane department. His headquarters will be at Philadelphia.

W. & L. E. GURLEY, Troy, N. Y., makers of surveying and hydraulic instruments, announce the appointment to their engineering staff of C. C. Covert, who, for the past twenty years, has been closely identified with the stream gaging work of the Water Resources Branch of the U. S. Geological Survey in Alaska, Michigan and New England and, for the last thirteen years, as district engineer at Albany, N. Y. Mr. Covert's services will be available in connection with the installation or operation of the Gurley line of hydraulic instruments, water stage registers and current meters.

AUSTIN MACHINERY CORP. has moved its accounting, publicity, and sales promotion departments to Toledo to join the administrative offices located there, as noted in this journal Nov. 9. At Toledo has been centralized the manufacture of the company's various lines of earth moving and concrete machinery. The Chicago office remains at 603 Railway Exchange Bldg., in charge of Henry Lamont. Arthur Cameron is with the company in Toledo.

STREET BROS. MACHINE WORKS, Chattanooga, Tenn., and the Patten Manufacturing Co., of the same city, have consolidated under the name of Street Bros. Machine Works, Inc., for the manufacture of hoists, derricks, derrick cars, cableways, and windlasses. The consolidation became effective Nov. 1.

HOWARD RHODE, formerly advertising manager, Lehigh Portland Cement Co., Allentown, Pa., has been promoted to the position of manager of the company's service department. H. M. Eichelberger succeeds Mr. Rhode as advertising manager.

Equipment and Materials

Fibre Flooring Made From Shoe Factory Wastes

A new type of industrial flooring in which waste materials from its tanneries and shoe factories are employed has been developed, after three years of experimentation, by A. C. Denning, manager of the fibre-board department of the Endicott-Johnson Corp., leather-shoe manufacturers, of Johnson City, N. Y. At the present time the company has 300,000 sq.ft. of this flooring in use at its own plant and experience with it in actual service is said to indicate many desirable qualities, among which are durability, non-slipperiness, non-conductivity of heat or cold, non-inflammability, noiselessness, and resiliency to a degree which largely eliminates foot troubles on the part of industrial employees.

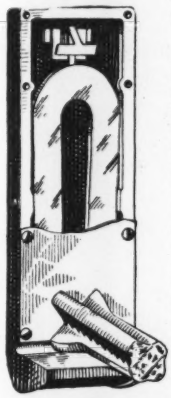
The material is made in two thicknesses, $\frac{5}{8}$ and $\frac{7}{8}$ in., in slabs 16 in. wide and 28 in. long; the latter dimension, however, may be varied. The fibre flooring is preferably laid over wood and fastened with staples between the laminations of the fibre through which steel rods pass; the staples are countersunk down to the rods. The sections are usually laid to break joints. Mr. Denning reports that the laying of this fibre flooring over concrete also has been successful; in that case, the material is bonded to the concrete by the use of hot pitch.

"We have selected the most difficult places for testing this material," Mr. Denning informs *Engineering News-Record*. "For instance, on our freight elevators where enormous trucking is had wear has been negligible over a period of two and a half years. In our

horse stables the fibre flooring shows absolutely no signs of wear after horses, sharp shod, have been tramping on it for two winters."

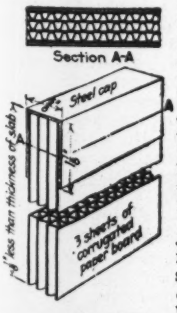
Magnetic Device Aids Blacksmith in Quenching Drill Steel

A magnetic indicator to assist blacksmiths in quenching drill steels at the proper temperature has been developed by the Sullivan Machinery Co., Chicago, as an accessory to its drill-steel furnace using oil or gas fuel. Drill steel, the company points out, in order to be tempered for the greatest possible toughness and resistance to wear should be quenched at the lowest possible temperature above the critical point, at which the structure of the steel changes. The fact that steel loses its magnetism at this point is the basis of the design of the magnetic indicator. The device consists of a brass or bronze casing with a common horseshoe magnet hung on a pivot as shown in the drawing herewith. At the top is a window and indicator tab painted white, balanced so that when the bottom of the magnet is impelled forward the top will strike a lever and throw the indicator into view. For testing drill steel temperatures a shelf is provided at the bottom of the casing as a rest, the point of the steel butting against the casing in front of the magnet. If the bottom of the magnet is pulled forward, making the white tab show in the window, the blacksmith knows that there is still some magnetism left in the steel and returns it to the furnace for further heating. If the magnet does not move, thus failing to bring the white tab into view, the steel is ready for quenching. The indicator is 9 in. long, 3 in. wide and 1 in. thick. It weighs 4 pounds.



New Type of Expansion Joint for Concrete Pavement

By the use of a removable steel cap and lengths of corrugated board paper, which are removed to allow for the pouring of a hot asphaltic filler, W. F. McGovern, superintendent of construction for the New Jersey State Highway Commission, Trenton, N. J., has devised a concrete pavement expansion joint for which patent applications have been made. The details of the joint are indicated in the accompanying sketch. Three lengths of corrugated paper board, held in place by a steel cap in the form of a channel at the top, are set across the line of the pavement where it is desired to form the expansion joint, the top of the cap being about ⅛ in. lower than the finished grade to permit of the passage over the joint of a finishing machine or screed.



After the concrete has attained its set, the steel cap is removed and a heavy butcher's knife is passed along between the pieces of corrugated boards, crushing them and making possible their removal. There is formed, in this way, a groove extending through the thickness of the paving slab, into which hot asphalt is poured. It is claimed that the joint thus formed is simple to construct, is waterproof and insures smooth riding qualities in the finished pavement due to the fact that the finishing machine passes over slabs on either side of each joint, thus bringing the joint edges to the same level.

Largest Railroad Wreck Crane Has 200-Ton Capacity

What is claimed to be the largest railroad wreck crane ever built has recently been shipped by the Industrial Works, Bay City, Mich., to the Virginian Ry. Co. With all outriggers set it has a capacity of 200 tons at 17 ft. 6-in. radius, as against 160 tons which was the previous record capacity for equipment of this type. With end outriggers only the new crane for the Virginian has a capacity of 100 tons and without outriggers a capacity of 42½ tons at the 17 ft. 6-in. radius. The capacities on the auxiliary hoist are 45 tons at 24- to 30-ft. radius with end outriggers only and 30 tons at 24 ft. radius without outriggers.

The crane is mounted on special six-wheel trucks and has a maximum axle load in running order of 32 tons. The car has a total wheel base of 26 ft. 2 in. and is 34 ft. long. The crane is 15 ft. 9 in. high at its highest point and 10 ft. 6 in. wide at its widest.

The engines are 12 x 12 in. and steam is provided by a 65-in., 160-lb. A.S.M.E. boiler. A Westinghouse air pump is provided with clasp brakes on each of the twelve wheels. The brakes may be operated by the engineer on the crane or by the engineer of the locomotive which may be hauling it in a train. All clutches are operated by air. The crane in running order weighs 356,500 lb.

The main design problem met with in building this crane was to keep within railroad clearances and the maximum allowable axle load—on account of bridges—of 65,000 lb. and still to obtain the 200-ton capacity required by the excessively heavy rolling stock and motive power in use on The Virginian. The crane was designed and built complete in the plant of the Industrial Works, and was tested before a distinguished party of railroad men from all over the country.

Publications from the Construction Industry

Motor Trucks—GENERAL MOTORS TRUCK CO., Pontiac, Mich., features its 1-, 2-, 3½- and 5-ton trucks in a 23-p. illustrated booklet. Among the special features of these trucks are removable cylinder sleeves in the engine, a positive pressure oil system operated by a gear pump and, in all models above 1-ton capacity, a two-range transmission, the first range for rapid movement on good roads and the second range for increased pulling power, at lower speeds, on poor roads. For all models above 1-ton capacity a worm drive is employed.

Alloy Iron for Castings—BETHLEHEM STEEL CO., Bethlehem, Pa., is distributing a 28-p. illustrated booklet describing the distinctive features of Mayari pig-iron, a natural nickel-chromium alloy iron for making high-grade castings. The ore comes from the northeast coast of Cuba. The use of this iron, it is claimed, produces castings with increased strength and solidity, better surface, reduction of spongy spots and segregations, fine machining qualities, and long life when subjected to heat and wear. Unlike other alloys, this iron is a natural product, nickel, chromium and other elements being intimately mixed in the native ore without any additions in the smelting process. A table is given showing the proper percentage of Mayari iron in mixtures for castings to serve different purposes, such as brake shoes, car wheels, engine cylinders, grate bars, sand pumps, valves, crusher heads, and superheated steam fittings.

Portable Loaders—LINK-BELT CO., Chicago, has published a comprehensive 32-p. illustrated catalog covering its entire line of portable loader equipment. Complete specifications are given for all of the standard machines, which include the large one-man power swiveling loader, the portable belt conveyor, the standard type A machine for anthracite, and the CS loader for sand and gravel. A well selected group of photographs and drawings illustrates the various types of machines and their uses. The equipment featured in this catalog represents a development based on fifteen years' experience in the manufacture of material-handling machinery.

Rust-Resisting Iron—CUTLER STEEL CO., Pittsburgh, after research work covering a period of twelve years, has developed a chromium iron alloy which is described under the trade name "Duraloy" in a 4-p. folder. Developed primarily as a low-cost alloy to resist oxidation, it was found to possess, its manufacturer states, not only this property but also a resistance under certain conditions to corrosion, a high tensile strength at extreme temperatures, and resistance to wear and abrasion. The metal is now furnished commercially in forms including castings, rolled or forged bars, sheets, wire and tubing.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Week's Loadings Over Million —Still 179,000 Cars Short

Present Records, Index To Business Conditions — Indicate Recovery From Post-War Deflation

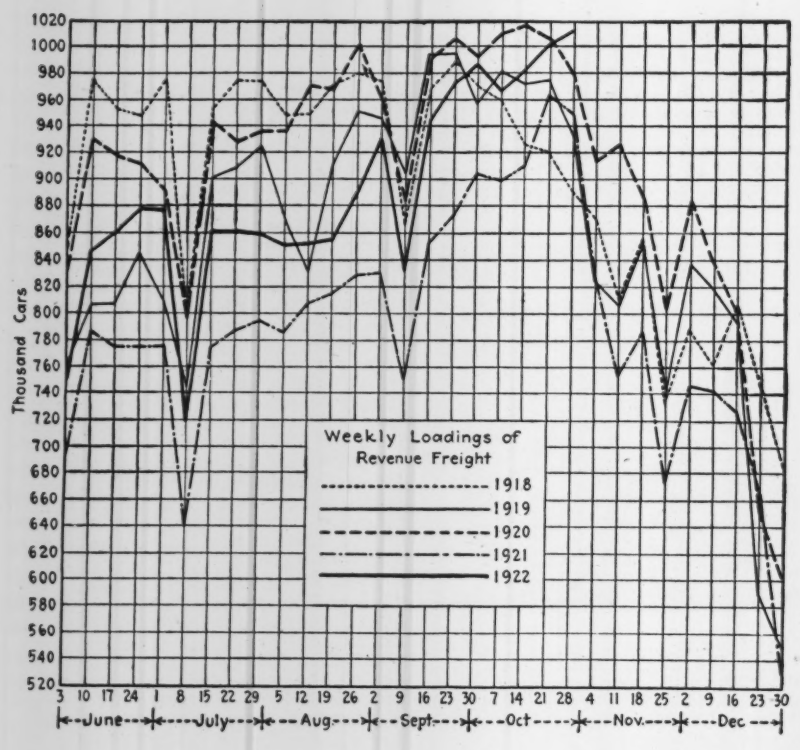
"If there existed any adjusted period in the country's history which might with certainty be termed 'normal' the present record car loadings indicate a full and complete recovery from the periods of post-war deflation," states the American Railway Association in its bulletin of Nov. 9.

"The fluctuation in the progress of agriculture and industry during and since the war," continues the report, "is depicted in the depressions and peaks of the curves for the various years, and an analysis of economic conditions existing during periods of low carloadings gives a fairly accurate picture of the causes of price decline and periods of inflation.

"In analyzing the trend of the loading for 1922 in relation to former years, it will be noted that in spite of the fact that the year was commenced with extremely low loadings, a gradual and healthy improvement is indicated up to the period of the coal strike. The disarrangement in this industry, coupled with the effect of the shop strike on the railroads which commenced on July 1, retarded the accomplishment of an immediate return to a period of exceptionally heavy carloadings and an upward trend of prices. Commencing in August, however, the recovery of the railroads was rapid and with the resumption of coal mining in the union fields carloadings have increased to a point where for the week ending Oct. 28 they were but a fraction of one per cent under the highest week in the history of the railroads.

"While the general trend of the curves indicates a falling off of business during the months of November and December, this period has been forced ahead during 1922 to a point where we can reasonably expect a continuance of exceptionally heavy loading this year beyond the period of prior years.

"It is reasonably certain, therefore, that the entire year of 1922, when completed, will be indicative of the fact that business conditions throughout the year and the performance of transportation will lend special emphasis to improved economic conditions and a return to so-called 'normal' conditions."



Peak loadings of revenue freight, throughout the five-year period, occurred during the following weeks:

Date	No. of Cars
1918—Sept. 23	989,788
1919—Sept. 23	995,901
1920—Oct. 14	1,018,539
1921—Oct. 21	964,811
1922—Oct. 28	1,014,480

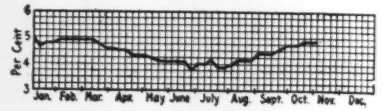
Of the 2,272,680 freight cars on all Class One roads as of Nov. 1, 249,960, or 11 per cent, were in need of repairs as compared with 11.9 per cent in bad order, Oct. 15, 1922. About 110,040, or 10.5 per cent, of the total number on line were box cars; 109,967, or 11.5 per cent, coal and 10,433, or 10.9 per cent, flat cars.

Business Briefs

Employment increased in fifty-six of sixty-four representative cities of the United States during October, according to the United States Department of Labor.

Bank debits for the week ending Nov. 15 totaled $9,244,000,000 compared with $8,204,000,000 for the preceding week, which included Election Day, and $7,693,635,000 for the corresponding period one year ago. This year's figures are larger than last year's for all the leading cities.

Money was firm on time loans but cheapest since Nov. 18 on call. Call rate 3½ to 5 per cent last week, 4½ to



5 early this week. No change expected in the immediate future. The year's range of time loan rate is given in the chart.

Bond market still slow. Par value of bonds sold last week on the New York Sock Exchange totaled $78,663,000, against $96,480,950 and $80,580,850 in the corresponding periods of 1921 and 1920, respectively, according to *Annalist* figures. Commonwealth Edison Co. $7,143,000 first mortgage 5s, due 1943, offered at 99 and interest to yield 5.07 per cent, were successfully floated. Liberty bonds unsettled, due to rumors of revival of soldiers' bonus, net result being a decline of 32@72c. per $100. Municipal bond market dull.

A "saving wage" was recently substituted by a public man for a "living wage." An article in the New York *Times*, Nov. 19, states that "the declaration of Senator Cummins (chairman of the Committee on Interstate Commerce) for incorporation of a living-wage provision in the Transportation Act has lifted the discussion (of what is a living wage) from the theoretical to the practical." Opinions differ as to what a living wage should be, but all agree that it cannot be more than is earned. In February, 1922, the National Conference Board conducted a survey of prices in the anthracite zone and submitted the following budget for a single man:

Room and board	$416.00
Clothing	136.12
Carfare	30.16
Recreation	18.20
Tobacco, candy, etc.	15.60
Reading material	10.40
Church and charity	5.20
Insurance	9.36
Medical care	9.36
Toilet articles, etc.	10.40
Laundry	26.52
Organizations	10.40
Personal taxes	6.24
Total	$703.96

General Wholesale Price Level Up Fraction of Per Cent in Month

Wholesale prices of commodities averaged higher in October than in the month before, according to information gathered in representative markets by the U. S. Department of Labor through the Bureau of Labor Statistics. Measured by the Bureau's weighted index number, which includes 404 commodities or price series, the increase in the general price level was approximately ¾ of one per cent.

Farm products again showed large increases. In this group prices in October averaged 3¾ per cent higher than in September. In the group of miscellaneous commodities, the increase was 3½ per cent. Food articles advanced 1½ per cent and cloths and clothing, 2¾ per cent in average price from September to October. Building materials and housefurnishing goods showed an increase approximating 1¾ per cent, while metals and metal products increased less than one per cent.

Continued decreases took place in the group of fuel and lighting materials, bituminous coal and coke declining rapidly in the face of increased production. No change in the general price level was reported for the group of chemicals and drugs.

Of the 404 commodities or series of quotations for which comparable data for September and October were obtained, increases were shown in 216 and decreases in 79 instances. In 109 instances no change in prices was reported.

INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES

(1913=100)

	1921	1922	
	October	September	October
Farm products	124	133	138
Foods	140	138	140
Cloths and clothing	180	183	188
Fuel and lighting	189	244	226
Metals and metal products	116	134	135
Building materials	159	180	183
Chemicals and drugs	131	124	124
Housefurnishing goods	180	173	176
Miscellaneous	118	116	120
All commodities	142	153	154

Comparing prices in October with those of a year ago, it is seen that the general level has increased 8½ per cent. Fuel and lighting materials show the largest increase, 19½ per cent, with building materials and metals coming next with increases of more than 15 per cent.

Alabama Passes Improvement Bonds

In the general election held Nov. 7 two constitutional amendments were passed by the State of Alabama by large majorities, which make available considerable funds for public works construction. The first amendment authorized the state to lend its credit to the State Dock and Harbor Board to the amount of $10,000,000 for the construction of docks in Mobile Bay. The work will proceed along the lines followed by Louisiana in work at New Orleans. A meeting of the Dock and Harbor Board has already been held for the purpose of outlining a construction program.

Another amendment to the constitution allows twelve small cities of the state to issue water-works bonds in excess of the present debt limit.

How Much Does Structural Steel Cost?

A correspondent writes that structural steel can often be bought at $10 to $11 per ton less than the warehouse prices quoted weekly in *Engineering News-Record*, and that the published prices must therefore apply to small lots. This is essentially true, inasmuch as large orders are usually placed at the mills. Orders out of stock vary up to 500 tons. and stock prices quoted in the *News-Record* apply up to that quantity. With present low demand orders from stock are said to average one ton. One of the largest dealers in New York maintains a warehouse stock of 25,000 tons, and 500 tons was the heaviest order received in recent years.

Readers interested in the price of steel in large quantities should note both the mill quotations quoted each week in this section and the unit prices on actual contracts published in Construction News. When demand is active quotations on large orders are sometimes as high as on carload lots. Conversely, when orders are at a premium a large order may be placed at a figure under the formal quotations. This is the case in nearly all trades.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 267 to 278, are the following:

Stadium, with complete system of roads around same, Berkeley, Calif., for University of California, $1,100,000.

Hotel, ten story, Duluth, Minn., for Duluth Residential Hotel Co., $1,000,000.

High school, for City of Boston, Mass., $1,000,000.

Hospital, Houston, Tex., for G. Herman Estate, first unit, $400,000; total cost to reach $1,000,000.

Railway, 29½ mi., Ontario, Canada, for Canadian National Railways, $1,500,000.

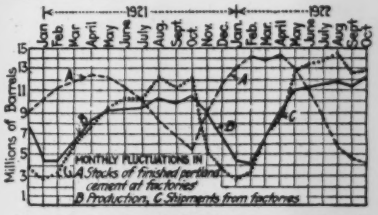
St. Louis Plans Extensive Paving Program for 1923

Expenditures in St. Louis for municipal paving for next year will amount to approximately $6,000,000. As in most American cities, in St. Louis paving fell during the war far below demand. The street paving itself dropped to an average of 12 miles a year for four years. While this to some extent has been made up in the work of the last two years, the condition is still far from satisfactory. The program for the present year entailed the expenditure of $2,500,000, but on account of the strike situation approximately one-third remains uncompleted. The program for next year will be an increase of about 500 per cent over the average work for several years preceding.

All of this work is paid for in special tax bills which require that the contractor finance the work until completion and then take payment in tax bills bearing six per cent interest. This tax bill provision has apparently prevented small outside contractors from coming in on St. Louis work during the period of expanding business, and may make it difficult to place satisfactorily the business proposed for the coming year.

October Cement Shipments Heavier Than Year Ago

Cement production figures for the entire country, as compiled by the Geological Survey, totaled 12,287,000 bbl. during October. This is an increase of nearly 17 per cent over the 10,506,000-bbl. total for October, 1921. Shipments, however, reached 12,854,000 bbl. as against 12,114,000 bbl. for the corresponding period last year, which is of particular interest when considered in connection with the current car shortage. Mill stocks amounted to 4,157,000 bbl., on hand Nov. 1 as compared with 5,348,000 bbl., available at the same time last year.



Department of Commerce statistics show that cement imports, from Sept. 1 to 21 inclusive, amounted to 42,641,000 bbl., valued at $88,724. Shipments were received mainly from Canada, Denmark, Belgium, Japan, Mexico and Norway. Cement exports totaled 78,615 bbl., valued at $219,898.

Los Angeles Votes $5,000,000 for Extending Water System

At the Nov. 7 election, voters of Los Angeles, Calif., approved by a majority of more than two to one, the proposition to incur a bonded debt of $5,000,000 for constructing and completing extensions and improvements in the water-supply system. The proposed work includes the following:

Improvements	Estimated Cost
Tujunga Reservoir	$650,000
Tujunga trunk line to reservoir	486,000
Trunk line, Tujunga Reservoir to Main City	510,000
Stone Canyon Reservoir, one-half cost	338,000
Harbor district, improvement of water supply system	125,000
Twenty-four inch cast iron line, along Hooper Ave., between 16th St. and Vernon Ave.	150,000
Haiwee Reservoir enlargement	125,000
Corporation yard and shops	550,000
Rowena pumping plant and trunk line, Rowena Reservoir to Highland Reservoir	230,000
Miscellaneous supply trunk lines, reservoir construction and reservoir sites	2,050,000
Total	$5,214,000

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 267 to 278, are the following large projects:

Bank and office building, Fresno, Calif., to R. F. Felchin Co., $750,000-$1,000,000.

Apartment, nine story, San Francisco, Calif., to Clinton Construction Co., $1,000,000.

Hotel, eighteen story, New York, N. Y., to Thompson-Starrett Co., $6,000,000.

Dock, 7,000,000 ft., Vancouver, B. C., to S. E. Junkins & Co., $2,000,000.

Apartment, fourteen story, Chicago, Ill., to Paschen Bros., $1,500,000.

Montana Highway Department to Let 1923 Contracts Early

The Montana Highway Department will receive bids on fourteen road projects during the winter months according to present plans. A somewhat novel method is being employed to acquaint contractors with the character of the work in the various proposed projects in order that they may be able to bid intelligently when bids are called for. It is the plan of the department to complete the field surveys on a goodly portion of the 1923 projects before the ground is covered with snow preparing the plans as soon as possible thereafter. Contractors have already been advised of the work contemplated by the department and definite dates have been set for district engineers to accompany contractors over the proposed locations where they will have an opportunity to study the character of the material to be handled, and other local conditions. Upon the completion of plans the various projects will be immediately advertised regardless of the winter weather. In this manner it is hoped to bring the 1923 work to the construction stage as early as weather will permit in the spring.

The fourteen projects now proposed for 1923 construction have a total length of over 250 miles and are estimated to cost approximately $2,250,000. Surveys on a number of these are now in progress and plans are under way or complete on a few. Dates for inspection of the proposed locations of these have been set between October 23 and Nov. 13. The work is under the general supervision of John N. Edy, chief engineer.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.30	$3.80	$3.75
Structural rivets, 100 lb	3.85	4.60	6.00	3.75	4.00	4.80	4.50	—4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.04	3.85	4.00	2.92½	3.05	3.85	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	½+53.95%	45%	59½%	57-5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	45.82	55.00	51.17	54.16	63.61	53.00	+55.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	—1.75	—2.25	2.25	1.75	1.90	2.25	1.00	1.50
Sand, cu.yd	1.00	—1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.10	1.65	2.25	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	—38.00	40.00	51.00	—39.75	39.75	35.00	22.00	50.00
Lime, finishing, hydrated, ton	16.80@ 17.17	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	17.45@18.55	—11.50	9.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.0796	.065	....	.11	+.09
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	.93	.97	1.07	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.....	.....	.....	.50@.55	.56½	.50@.60	.....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Pig iron, coke, steel and iron scrap prices, all tending downward. Steel plate inquiries better, however, giving rise to quotations of $2@$2.10 per 100 lb., f.o.b. Pittsburgh. Demand for steel structurals quiet, with prices firm at $2 per 100 lb., base.

Atlanta quotes ¾-in. gravel at $1.75 as against $2 and sand at $1.32 as compared with $1.35 per ton, last week. Easier market reported as due to increase in car supply. Dallas also quotes reduction of 27c. per cu.yd. on ¾-in. gravel.

The yellow-pine market, while it remained unusually firm during the last month, is beginning to show some signs of weakening. Atlanta quotes $38 as against $42 per M. ft. b.m. on long-leaf yellow pine, base sizes; while Douglas fir is $39.75 in Minneapolis as compared with $41, one week ago. A total of 394 mills, reporting to the National Lumber Manufacturers' Association for the week ending Nov. 11, show a falling off of over 7 per cent in production; but a gain of one per cent in orders and 8 per cent in shipments. The industry now stands at a trifle over 5 per cent below normal as to production; with orders at 15 per cent and shipments, 20 per cent below normal.

About 150 bricklayers, members of the Bricklayers' Masons' and Plasterers' International Union, went on strike Nov. 17, in New York City. The trouble arose from the refusal on the part of the International Union, which is affiliated with the A. F. of L., to use materials handled by members of the Independent Laborers' Union, not affiliated with the Federation. The employers, represented by the Mason Builders' Association, intend to stand by the contract existing between themselves and the Independent Laborers' Union and continue to employ members of the latter organization.